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Plans, Achievements of High-Tech Development Areas Outlined

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[Text] Abstract: Based on systematic analysis of statistical data on science and technology provided by Beijing, Shanghai, Tianjin, Wuhan, Guangzhou and Shenzhen, preliminary plans were formed for the development of six high-tech areas in China: microelectronics, computers, biotechnology, fiber optic communication, laser technology and new materials.

A fundamental endeavor with far-reaching effects in China's high-tech development is the scientific planning of China's high-tech development areas and the systematic organization of the projects in each area. In this paper we will present a preliminary systematic analysis of the areas of high-tech development in China.

It can be said that to date there is no unified definition for the term "high-tech," which covers a wide range of topics. In order to make a focused study, we based our analysis on the information contained in the reports provided by the various areas in China and the data obtained by the general investigation group and tentatively identified major projects in six major areas: microelectronics, computers, biology, fiber optics, lasers and new materials. In many ways these are already established areas and are likely to be developed into major enterprises in China's high-tech industry. In our analysis of each topic, we shall compare and rank the scientific and technological ability of the different areas.

I. Microelectronics

Microelectronics has wide application in the consumer industry, computers, communications, instrumentation, industrial control, and military engineering. As China's economic development progresses, higher demands will be placed on various microelectronic products and technology. However, microelectronics technology in China is still rather undeveloped and the quantity and quality of integrated circuits are far from satisfying the needs of the national construction. For example, in 1984 alone China imported 120 million electronic circuits. Moreover, the production of computer and communication IC's is yet to be systemized, and raw material and special equipment are not meeting development requirements. Statistics show that there is potentially a very large market for microelectronics in China; during the Sixth Five-Year-Plan period, the demand for integrated circuits in China grew at an annual rate of 63.6 percent. In the Seventh Five-Year-Plan period, the great demand on microelectronics will be an extremely large driving force behind the development of the microelectronics industry. A development plan for microelectronics is therefore vital for China's electronics and information industry.

In our comparison, Beijing, Shanghai, and Nanjing are the strongest in microelectronics. The microelectronics industrial zones at Zhongguan village, Caohejing and Zhongshan are also stronger than other places. In fact, the concept of establishing two industrial bases for microelectronics, one in the north and one in the south, has basically taken shape. These three zones will help form a rational structure for China's microelectronics industry.

Detailed analysis revealed that Shanghai is particularly poised to absorb advanced foreign technology and to develop and manufacture microelectronic components. According to the research report of the Shanghai development zone, there will be eight major microelectronics component projects in the Seventh Five-Year-Plan period. A south China microelectronics technology development belt will be formed by the development of the Shanghai high-tech zone, the Wuxi integrated circuit production lines, and the development of the "Electronics City" Nanjing. Major projects in the Nanjing area will include microelectronics assembly technology, special circuits, auxiliary design of computers and auxiliary decision systems.

In terms of market needs, the prospects of the south China microelectronics belt are very good. In Shanghai the market share in the Sixth Five-Year-Plan period was 49.6 percent to 21 percent, and a considerable portion of the market was taken by foreign companies. In the future the pace for modernizing traditional enterprises will pick up and the need for various electrical circuits will increase.

The counterpart of the south China microelectronics belt in the north is in Beijing. Microelectronics will be vital to the development of the Beijing high-tech zone. Beijing is a concentration of science and technology resources including the Institute of Computers of the Chinese Academy of Sciences, Qinghua University, the Institute of Semiconductors, the North China Computation Institute of the Ministry of Electronics Industry and Beijing Aerospace. Along the famous "Electronics Street" in Zhongguan Village, there are 51 civilian microelectronics and computer enterprises engaged in application development, mostly secondary development. The Zhongguancun zone should therefore take the lead in the application and development of microelectronics and make use of the existing strength of a complete repertory of electronic sciences to modify old technology and create new technology.

A survey on the market needs of integrated circuits in Beijing showed that the total demand in the Seventh Five-Year-Plan period will increase at an annual rate of 38 percent. By 1990, 110 million integrated circuits (20 times the 1984 output in Beijing area) will be needed in television broadcasting, communications, machinery,

instrumentation and computer industries. Beijing is the window for foreign trade, production development will stimulate consumption and the development of microelectronics application will stimulate technology modification in different industries and further increase the market demand. Microelectronics is therefore one of the most important development projects in the Beijing high-tech development zone.

Although the technological and production capabilities of the Wushan and Shenzhen industrial zones are not yet fully developed, the special economic zone has certain advantages in introducing foreign capital and technology and attracting domestic money and talent. The planning of high-tech projects in the special economic zone should receive proper attention.

II. Computers

According to predictions, China will have 60,000 to 100,000 computers of various sizes and 1 million to 1.5 million microcomputers by the year 2000. Market predictions show that the sales of microcomputers alone will be more than 100,000 units per year. In the Seventh Five-Year-Plan period, China will have 11 large scale information and business system computer projects and 12 large scale engineering computer service projects. Statistics collected by the Ministry of Electronics Industry showed the need for 209 large computers, 1175 medium size computers, 15,598 small computers, and 156,571 microcomputers, The market for computers is enormous.

A comparison showed that Beijing is the strongest, followed by Shanghai and Nanjing, in the computer area. Beijing now has 14 production lines for computers and seven more are under construction. In addition to development and production units, there are also 30 computer centers (stations) and 20 universities with computer majors. The gross value of production of the computer industry in Beijing in 1984 was 230 million yuan. Serialized products in small computers and microcomputers also led the nation.

Shanghai is also very strong in computer design and production. Shanghai was able to design and produce third generation large and medium size computers in the mid 197O's. The main product line of Shanghai now is microcomputers and small computers. The annual output is 10,000 microcomputers and 200 small computers, but most of them are assembled from imported parts and serialized products have not been formed. In addition, Nanjing also has some computer manufacture capabilities.

Beijing and Shanghai possess the necessary technology and production facilities for developing computer (hardware). Other regions may also develop some unique computer products based on their particular situation.

In the computer arena software is extremely important. In computer application the value of software often exceeds that of the hardware. In China the software industry is still in its infancy and software production is still manual. Software development and production is therefore an important task in building China's computer technology. Whether it is politics, culture, or technology and economic development, the Beijing high-tech zone need to make software development a priority task. While developing software, we should build up data banks, Chinese signal processing software, networking software and other higher order languages and strive for the commercialization and standardization of software.

Under the interaction of foreign capital and domestic technology, Guangzhou and Shenzhen may begin with microcomputers and develop microcomputer systems and application software needed by the domestic and international market. Since Southeast Asia, the Mideast and Australia have no plan to develop large and medium computers, there is potential for export. Large and medium computers may be gradually developed into systems. A high quality, competitive, serialized product line may be formed by combining the development of integrated circuits, computers, and software.

III. Biotechnology

China has achieved fruitful results in genetic engineering, cell engineering, enzyme engineering, and fermentation engineering; some of the research results have turned into products on the market. However, on the whole China's biotechnology is still quite weak. The ability to develop new technology and products is poor and the tasks are uncoordinated. For an agricultural major power like China, it is essential to have well-planned and organized training of personnel and development of biotechnology projects.

A review of the statistics on biotechnology in the various regions in China shows that Shanghai is the strongest in terms of biotech capability and is also one of the first regions to start bioengineering research. Shanghai is followed by Beijing and Wuhan, and the three regions each has its own unique strength.

Shanghai is strong in genetic engineering, enzyme engineering, and cell engineering. In the last few years good results have been obtained in the genetic engineering development of penicillin amidase and insulin, in cell culture and cell fusion as applied to breeding and fast rearing of crops, in antibody preparation for liver cancer, lung cancer and hepatitis, in enzyme fixation as applied to the production of semisynthetic penicillin, concentrated fructose, alcohol and beer, and in research on amino acids, nucleotides and derivatives, enzymes, and single cell proteins. Some of these research results have already led to marketable products and can potentially industrialize fermentation engineering. The Shanghai high-tech zone can therefore make use of the existing technology of genetic recombination and cell fusion in its development of food, drugs and other biological products. Shanghai is one of China's largest industrial bases; the Shanghai high-tech zone has no excuse not to engage in the application of biotechnology research results, the

modification of traditional products and the development of new commercial biotechnology products.

In the Beijing high-tech zone, plant genetic engineering, animal genetic engineering, protein engineering, and cell engineering are at the forefront of international research. Zhongguancun now has 11 national level priority open laboratories and five other laboratories, with nine of these related to agriculture and botany. Many of the research results produced by these laboratories are closely related to agriculture and livestock breeding, such as hevea rubber haploid breeding, single cell hybridization, and cow and sheep embryo transplant. Being an agricultural country with a population of 1 billion, China is strategically well positioned to combine agricultural production with high-tech and thoroughly change the backward situation.

Biotechnology in Donghu zone in Wuhan is characterized by other strengths. Its cellular engineering and genetic engineering are applied to the breeding of fish; Donghu is the home of the world's first test tube fish. The goal in Donghu is now is to breed new species of fast-growing, delicious and nutritious fish. In addition, a virus diagnostic center using cellular hybridization technique will also be built to produce rare and precious materials with plant tissue culture method. These projects are highly beneficial to human eugenics and health and economic development. Fermentation and enzyme engineering in Wuhan, like that in Shanghai and Beijing, is also aimed at gradually improving traditional foods, drugs and wines.

IV. Fiber Optic Communications

Fiber optic communications is one of the pillars of an information society. Fiber optics can carry a large volume of information with very low transmission loss. It is resistent to electromagnetic interference and is therefore secure in transmitting information. It is also light, and can be easily manufactured from abundant materials at lower and lower costs. These advantages have made fiber optics prevalent in a number of areas of information technology. Fiber optic communications is not yet industrialized in China but the market need is great. According to the forecast of the Electronics Revitalization Office of the State Council, the yearly demand for fiber optics in the Seventh Five-Year-Plan period is 31,500 kilometers. Together with military needs, the growth in demand is even more substantial. Therefore, the development of fiber optic communications and the establishment of a fiber optics industry to promote general information technology will be a major thrust.

Statistics on capabilities in fiber optic communications showed that Shanghai and Wuhan are the front runners and Beijing comes next.

In 1978 Shanghai made a municipal-wide effort in fiber optic communications development and investment. It now has a complete facility for research and development and some ability for small batch production. The Shanghai area also has advanced electronics, instrumentation, machinery and chemical industries that can be matched with communication technology. In the Seventh Five-Year-Plan, there are several major technology import projects to make the technology base even stronger. Shanghai is evidently qualified to develop fiber optic communications as a priority task. Naturally, the technical resources now available for industrialization are far from adequate and a parallel effort to import foreign technology and train domestic technical personnel is needed.

The theoretical and technological capabilities in fiber optics in the Donghu region in Wuhan, particularly in the Wuhan Institute of Posts and Telecommunications, is almost as strong as those in Shanghai. Beijing also has certain unique capabilities in the development and fabrication of optical fibers. Beijing has entered the production stage for basic materials such as ultrapure reagents, silicon material, quartz, semiconductors and optical fibers. In these areas Beijing has the strongest research force and is capable of technology corroboration in a horizontal direction. Since Beijing is the political and cultural center of China and is the most crucial region for communication, fiber optic communications in Beijing should be established.

Fiber optic communications development in these three regions will begin with improvements and expansion of their municipal telephone systems, followed by contributions to national long distance trunk lines, ocean floor cables, defense communications, railroads, petroleum, and public security communications.

V. Laser Technology

Lasers are high intensity, monochromatic light with good directivity and coherence. Lasers are widely used in industrial communications, clinical treatment, scientific research and military applications. China has developed a number of lasers, some of which are commercialized. A survey of laser technology in the various regions of China revealed that more than half of the technological capabilities are concentrated in the Beijing region. Beijing also leads the nation in terms of research results in lasers. The Beijing Institute of Optoelectronics has developed a series of ruby and glass lasers, holographic equipment, high speed cameras, and automatic detectors. Beijing Industrial University has made laser signal processing and opto-acoustic control their priority research projects; they have developed and produced laser printers. If the high-tech zones can implement unified planning, strengthen the ties with production, and improve applied development, then the laser technology may be industrialized and contribute to the various aspects of production and society.

Laser technology in Donghu, Wuhan also has its merits. Examples of leading achievements are the high power CO_2 laser of the Central Engineering College and the laser ranger at the Wuhan Earthquake Laboratory. The Ministry of Posts and Telecommunications has already

determined to build plants in the Donghu region. In addition, some of the results obtained by the laser laboratory at Tianjin University may be considered for industrial "incubation" of high power laser technology so as to develop an active laser industry.

Laser technology is the basis for the opto-electronics industry and requires advanced skill and equipment. Advanced foreign technology should be fully exploited, for which the Shenzhen high-tech zone has distinct advantages.

VI. New Materials

Materials are the basis for information and energy. All new technologies rely on the invention and use of new materials. New materials is not only a field of technology in its own right, but also forms the basis of other high-tech areas. It plays an important role in improving traditional industry and technology. All countries in the world treat new material development as an important strategic measure. Once a new material is developed and deployed, its market demand is almost without bound and its value to the entire economic and social development is also impossible to estimate. High-tech industry in China must therefore be developed rapidly and independently, and new materials, must occupy an important position in such development.

Statistical data on new material technology showed that Tianjin, Guangzhou and Nanjing are all strong and Beijing also has its own strengths.

The Nankai high-tech zone in Tianjin has the highest concentration of material science resources. Research in metals has been going on for 30 years and major achievements have been obtained in high strength steel, elastic alloys and stainless steel. Composites, amorphous alloys, materials difficult to machine, and machine techniques are designated as near term tasks of the nation. High polymer material research has been leading the nation and some of the research results have reached or surpassed advanced international level of the 1980's. Important results have also been obtained in the study of inorganic non-metallic materials, such as high temperature ceramics, hydrogen storage materials and magnetic materials. Some of the projects in Tianjin will be developed and marketed in the near term, these include magnetic materials with a strong market demand and high value for application, amorphous silicon with a great future in microelectronics and communications, and the much touted structural and functional ceramics.

The Wushan high-tech zone in Guangzhou has made noticeable advances in silicon materials, organic high polymers, sensor materials, biomedical materials and surface treatment technique for metals. The Wushan high-tech zone has considerable potential in the development of new materials. It is suited for the development of sensing materials, memory alloys, semiconductors, magnetic powders, zirconia, and transducers. In addition, it can also develop surface treatment technology for metals.

Wuhan has achieved international status in organic silicon, organic fluorine, fiber optics, and precision ceramics. The research results on organic fluorine have already been applied in some priority national projects and foreign exchange in exports. Most of Wuhan's high tech forces are concentrated in Donghu where a priority program on new materials was established.

The technical team working on new materials in Beijing has made contributions to a wide variety of new materials research. Urgently needed new technology may be "incubated" in Beijing and then transferred to other regions for industrialization.

In China the level of scientific research in new materials is quite high but the development in manufacture and equipment is rather limited. If high tech zones in Shenzhen and Guangzhou can impart foreign equipment and manufacture technology, then, combined with China's scientific research results, more and better new materials may be developed and put on the international market.

The systematic analysis of high technology development is based on the current situation in the seven cities and based on development plans of the high-tech zones under construction or slated for construction. Due to various reasons in the science and technology and economic system in China, we did not touch upon some high tech topics such as aerospace, nuclear energy and oceanography, Actually, China does have unique capabilities in these areas, an example being the "two rockets and one satellite" project that showed the achievement in the defense area. However, due to the rigidity of our system and the lack of a classification-declassification system, the avenues for transferring such potentially useful high-tech results to the civilian sector for commercialization are temporarily blocked. Another problem is that, faced with economic construction and lateral cooperation, the military enterprises are not using high technology or new technology to improve conventional technology. Instead, they have set aside high technology and have been working on lower level conventional technology and projects. This practice not only wastes the technology resources and lowers the technical level of the entire enterprise, it is also detrimental to future development. In combining the military and the civilian sectors and in combining the defense and the economy, high tech bases should be formed around frontier defense projects. Such bases should interact with the defense units and receive technology transfer from the defense units. Periodically declassified technology can be transferred from the priority bases to the research and production units in the high-tech industry zones. Such technology may be further developed (secondary development) for more direct economic and social benefits. For example, if such secondary development bases are planned in the process of developing the northwest region of China, then, the development of high-technology may also carry along the development of the local technology economics.

In addition, automation technology and robotics will have an enormous impact on the modification of traditional industry and on the alteration of the industrial

structure. Such technologies are highly interdisciplinary and diversified, the high-tech zones should plan projects in this area according to their actual situation in order to revitalize and thoroughly change the makeup of the industry.

New Approach to Industrialization of High Technology

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[Article by Wu Yingxi [0702 5391 3556] of the Shanghai Branch, Chinese Academy of Sciences: "Explorations on Promoting Industrialization of High Technology—A Study of the Laser Industry Development Situation at the Shanghai Institute of Optics and Fine Mechanics"]

[Text] Abstract: This article summarizes methods and experiences at the Shanghai Institute of Optics and Fine Mechanics in reform and practice over the past few years and proposes certain positive opinions in an attempt at some preliminary explorations of systems and policies for promoting new technologies and industrialization of high technology.

I.

Laser technologies are another important discovery which followed the appearance of atomic energy, computer, and semiconductor technologies. The birth of the world's first solid laser in 1960 in the United States was followed 2 years later by the birth of China's first ruby laser, indicating that laser research in China was not late in getting started. However, lasers have now become an emerging industry in some European nations and the United States and are being extended and applied in a wide range of sectors including industry, agriculture, communications, medicine, the military, and so on, and sales of laser products on international markets surpassed $3 billion in 1987. In China, however, system defects and policy mistakes caused a detachment of scientific research from production and a detachment of military from civilian uses. Although 500 or 600 scientific research achievements were made in research work over the past 20-plus years, they basically have remained at the sample and display stage. The value of output for laser products in China as a whole is less than 100 million yuan, less than 1 percent the amount in the United States.

The Shanghai Institute of Optics and Fine Mechanics was one of the first units in China to undertake laser research. The institute has over 1,400 employees and 768 S&T personnel, including 148 advanced personnel and 399 mid-level personnel. The institute's main tasks since its founding have been to engage in high power laser research and rely on "the emperor's grain" to get by. While there have been readjustments in tasks and intensive reforms over the past few years, comrades at the Shanghai Institute of Optics and Fine Mechanics earnestly summarized their historical experiences and lessons to renew their research and determine development orientations and models for the institute.

In recent years they used this model as a foundation for brave reform and bravely opened up. They mobilized and organized over 100 S&T personnel to "go down to the sea" and integrate with township and town enterprises to establish 13 jointly-run plants related to laser equipment, laser processing, and associated laser parts and components. Their value of output exceeded 10 million yuan in 1988.

Their main methods were:

First, actively participating in Shanghai's plans to develop the laser industry and adopting the "five provisions." This method involved providing achievements, technologies, capital, equipment, and personnel for integration with township and town enterprises to establish jointly-run plants, which greatly accelerated laser product development.

Since 1985, with support by the Shanghai Municipal Economic Commission, Planning Commission, Science and Technology Commission, and other relevant departments, they have actively developed kW-grade carbon dioxide lasers and over 10 other product items and made gratifying progress in the area of conversion to products. In 1987, adoption of the "five provisions" method greatly accelerated the pace of joint management and product development and production. According to statistics for seven jointly-run plants established by the institute, the Shanghai Institute of Optics and Five Mechanics invested 3.6 million yuan, including an investment of 1.54 million yuan in fixed assets, equal to about one-half the total investment in the jointly-run plants. The institute now has 72 S&T personnel working directly at the jointly-run plants in positions like managers, assistant managers, senior engineers, and senior technicians, and in developing new products, management and administration, and other areas.

Second, they began with market demand and focused on developing key laser technology products produced in significant quantities and establishing production systems for matching component technical products to gradually form a rather complete laser product system.

To speed up development of China's laser industry, the Shanghai Institute of Optics and Fine Mechanics began with market demand in formulating several key development projects for laser printers, photoetchers, lasers used in laser processing, medical lasers, and others to form key laser technology products in significant amounts. At the same time, they made corresponding improvements in matching component products for the laser industry and established rather complete and effective production systems, fine mechanics processing plants, and precision instruments production plants with stable products. The jointly-run plants they have established include a laser processing equipment plant, medical laser instrument plant, an electrical power source plant, light source plant, and multicrystalline and optical

components plant for matching with lasers. At the end of 1987, the Shanghai Institute of Optics and Fine Mechanics joined with Jiaxi Industrial Company in Jiading County to establish the Shanghai Lei'ou Laser Equipment Plant to concentrate forces for developing and producing industrial high power carbon dioxide lasers. The kW carbon dioxide lasers produced at this plant are ideal laser components for use in laser thermal processing in China at the present time and they have attained the level of similar products in foreign countries. They have stable performance, strong applicability, and a price far below foreign products. They have received good evaluations from users. The high power lasers can be used in a wide range of areas for thermal processing, cutting, welding, and so on, and they have significant economic benefits. The Qingdao Engine Plant has successfully used a kW carbon dioxide laser provided by the Shanghai Institute of Optics and Fine Mechanics for rapid laser quenching of diesel engine cylinders. The projected annual economic benefits may reach 10 million yuan. The Lei'ou Laser Equipment Plant's rather strong matching forces for lasers, fine mechanics, electrical technologies, and advanced equipment provided reliable technical guarantees for the quality and advanced functions of this product. This has made the product highly competitive in the market. They plan to spend 3 to 4 years to achieve a production capacity of over 30 units yearly.

Third, they developed export-oriented products, expanded Chinese-foreign cooperative development, and tried to put more products into international markets.

Leaders at the Shanghai Institute of Optics and Fine Mechanics feel that high technology industry development requires products that are export-oriented, have international markets, and can replace imports. A few years ago, although they exported some products and earned foreign exchange, they basically were experimental products produced in small amounts without stable quality, so they could not provide products in significant amounts and with stable quality for foreign purchasers. They even found it hard to provide significant numbers of samples, which restricted export development and foreign exchange earnings. Establishment of the jointly-run plant has given the product a more stable production base area. To open up exports to earn foreign exchange over the past few years, they actively sought international cooperation partners and established Chinese-foreign joint investment enterprises. To date, they have established joint investment enterprises with three foreign companies which have completed major projects within China and projections are that more products will enter international markets.

II.

The experiences of Shanghai Institute of Optics and Fine Mechanics during preliminary practice in laser industry development are very important. Their primary experiences were:

First, emphasize conceptual changes, straighten out relationships, and make stronger technical development and opening up the laser industry the main parts for achieving a research institute development model.

Since 1985, the Shanghai Institute of Optics and Fine Mechanics gradually formed a rather clear program through research and discussion. In early 1987, the institute director issued a formal call at an institute conference for all institute employees to unify their understanding, truly achieve a change in ideology, concepts, and working styles, and derive a reform model adapted to laws of scientific development and actual conditions in the institute. Later they outlined this model thusly: gradually form a research institute focused on applied research and an institute-run development company focused on product development and production. They also hope that the institute-run company will gradually grow into a company-run institute as the company expands in scale. To achieve this reform model, they straightened out relationships among basic research, applied research and development, and straightened out relationships among scientific research, production, and administration. They clearly proposed that one aspect should be maintaining crack forces (10 to 20 percent of the S&T forces in the entire institute) for basic research, with groups of comrades frequently examining world S&T trends, continually noting the forefront of disciplinary developments, opening up new realms, making scientific research achievements at world levels, and training personnel with a solid foundation and strong creativity. They also must focus on important applied research and try to play a bigger role in state development of strong laser technologies and laser electronics technologies. In another area, they made a faster pace of product development and service to the laser industry important parts of achieving the institute development model. Development work was a permanent principle, not an expedient. A substantial part of the institute's S&T personnel have gradually shifted into product development and production. Product development must begin with market demand, and the market share of products must be studied. They have changed the concept of viewing production sales and services as low-level work. S&T personnel engaged in product development and administration work should have different evaluation standards than for basic research. Product development systems cannot be closed, but should instead be open and integrated systems. The main product development goals are to form high technology laser and optoelectronics industries while also being concerned with products that sell widely, provide high short-term value of output and profits, and so on.

The Shanghai Institute of Optics and Fine Mechanics began with the overall situation, rather comprehensively considered and determined the institute development model, dealt correctly with the various relationships involved in S&T development, adhered to the correct orientation of service to national economic construction, and laid the task of industrializing laser technology in

front of all the institute's S&T personnel. This laid a good foundation for motivating the S&T personnel to devote themselves to active development of the laser industry.

Second, mobilize and organize a large number of S&T personnel to devote themselves to practice in developing the laser industry, truly allow them to "go down to the sea" and meet the crashing waves by gradually preparing S&T industrialists who understand S&T as well as administration and management.

Personnel, technology, and capital are the basic elements in high technology company development. Personnel are the most important resource in high technology company development. If the United States did not have many capable and ambitious scientists and engineers with a creative spirit, there would be no "Silicon Valley," the heart of the United States' microelectronics industry. Industrialization of high technology industries in China requires a new generation of S&T entrepreneurs. Over the past few years, a large number of S&T personnel have taken the path of integrating production and practice, and many S&T personnel in all Chinese Academy of Sciences institutes in Shanghai have taken joint appointments in many areas as plant managers, assistant managers, technical consultants, and so on in jointly-run plants. They have made the necessary contribution to commercializing scientific research achievements. However, most have joint appointments and too many tasks for one person, so they cannot completely adapt to the need to expand new industries. The Shanghai Institute of Optics and Fine Mechanics began with the need to open up China's laser industry, and used repeated propaganda and education and formulation of the necessary incentive policies to mobilize and organize over 100 S&T personnel to devote themselves to opening up the laser industry. Moreover, 64 comrades went directly to the plants for product development and production, but they bear a heavy technical and administrative burden in the jointly-run enterprises. This was a major improvement over previous methods. Practice has proven that without a large group of comrades to devote themselves and struggle hard, industrialization of high technology is difficult to achieve.

Several S&T personnel in the Shanghai Institute of Optics and Fine Mechanics were very good at explaining problems during the process of developing and producing "lithium tantalic acid crystals." Plant construction required adding two new crystal growing ovens and obtaining platinum to build the ovens. No platinum was available in China, however, so it must be imported at $16,700 per kilogram. Where would this much foreign exchange come from? A big problem was encountered during plant construction. The S&T personnel who was the assistant manager of the plant had worked in the institute planning office and had wide-ranging social connections. He quickly understood that Chuansha County had a plant which had produced lithium niobium acid crystals but had now ceased doing so. He guessed that there was platinum available so he immediately established a relationship. However, the plant's platinum had been mortgaged by creditors, and after consulting with several parties, he bought 1 kilogram of platinum. This amount was still far less than needed, but he then learned that in Beijing there was a plant which also had terminated a lithium niobium acid crystal project and that it had 20 pieces of equipment and 5 kilograms of platinum lying idle in the warehouse. They negotiated for 6 consecutive days and he quickly purchased the platinum to meet the needs of trial production. This also saved several 100,000 yuan for the plant. During production of lithium niobium acid, there was one technique which originally used polarized crystals plated with gold leaf at rather high cost. This was particularly true of problems with gold supplies, so further improvements were needed to meet production requirements at the plant. S&T personnel responsible for polarization techniques unhesitatingly conducted experiments with the new technique, used no more gold, and were successful. This improvement alone can save our 14,000 yuan annually.

Moving from laboratory accomplishments to production on a plant scale can involve many new technical problems as well as many new management and administration problems, so the leaders of the Shanghai Institute of Optics and Fine Mechanics began with this prerequisite and were determined to mobilize and organize a large number of S&T personnel for difficult pioneering work. They hoped that relying on the intellect and hands of these S&T personnel could quickly bring China's laser industry into being.

Third, establish jointly-run plants which integrate technology, industry, and trade, closely integrate research institute advantages with China's most vigorous township and town enterprise advantages.

Total reliance on a research institute for development and production is not possible, so there must be integration with enterprises. However, with which enterprise should they integrate? How can integration be achieved? The appropriateness of the choice made could determine success or failure.

In the new situation, what steps should be taken to develop the laser industry? After full survey research and practice, comrades at the Shanghai Institute of Optics and Fine Mechanics felt that the most ideal choice was to integrate with vigorous township and town enterprises and establish jointly-run plants which integrate technology, industry, and trade to take fullest advantage of both sides in promoting industrialization of laser technologies. Local governments and township and town enterprises played a significant role in establishing jointly-run plants. Practice in establishing jointly-run plants shows that they can be expressed primarily in the following areas:

1. They provided the extremely valuable several 10 mu of land and 5,000 m^2 of ready-made plant buildings

during plant construction, which enabled several plants basically to build and place them into operation concurrently.

2. They provided nearly 4 million-plus [as published] yuan and over 400 new contract system employees of rather good quality.

3. Local government concern and support enabled many jointly-run plants to handle the various application and approval procedures involved in establishing enterprises and basically turned on a green light. They also gave effective support in the area of public and household services.

4. Joint administration with township and town enterprises was an extremely effective mechanism economically and they can implement definite economic encouragements in allocations for S&T personnel involved in product development.

Lasers are a high technology industry, but they also are a high technology industry in which small companies can participate in administration. Practice has shown that joint administration by the Shanghai Institute of Optics and Fine Mechanics and township and town enterprises and close integration of the technical advantages of the research institute by means of the "five provisions" with township and town enterprises is an excellent arrangement to promote industrialization of China's laser industry.

III.

Initial practice by the Shanghai Institute of Optics and Fine Mechanics in developing the laser industry has enabled even better promotion of the industrialization of high technology, and there are some policy issues which require further study.

First, concerning policies to stimulate S&T personnel to participate in industrial development.

Many S&T personnel in the Shanghai Institute of Optics and Fine Mechanics want to make more real contributions to the nation and have bravely participated in activities to develop high technology industries, but the difficulties they face are not understood by everyone. They must face technical risks and market risks in product development, and they must bear the burden of the mistaken view that those who manage the plants are "incompetent researchers." A common statement is that key cadres who went to jointly-run plants have seen their hair become grayer.

According to statistics from a jointly-run plant, the original average monthly wage of the 12 S&T personnel and three technical workers from the Shanghai Institute of Optics and Fine Mechanics was 102 yuan/person. After going to the jointly-run plant, their basic wage rose by 80 percent over the original base number to an average wage of 183.6 yuan/person, an average increase of 81 yuan per person. Generally speaking, they still are not receiving appropriate compensation for the labor they expend and there is great asymmetry between the remuneration they receive and the results they create. If this situation persists for any period of time, it will not be possible to stabilize and stimulate more people to participate in industrial development activities. Thus, we should closely study policies to link remuneration for labor and economic results for S&T personnel engaged in industrial development, which would give their pioneering activities even greater labor power and energy.

Another question of concern to S&T personnel is evaluation and setting of job titles. Leaders in the Shanghai Institute of Optics and Fine Mechanics discussed making product markets, value of output, and other economic results the criteria for evaluation standards for S&T personnel engaged in product development, but the lack of clear policy stipulations has led to overly strict control over job titles of some comrades and affected their initiative.

Second, concerning implementation of a relaxed "blurred transition" policy to promote personnel circulation.

The present situation for the S&T workforce in the Shanghai Institute of Optics and Fine Mechanics is that the top and bottom levels are small while the middle is large, with mid-level S&T personnel comprising about 52 percent. Thus, encouraging some mid-level S&T personnel to move to jointly-run plants is necessary for opening up high technology industries and for making greater use of their roles. Mid-level S&T personnel themselves have two apparent characteristics. One is that many comrades have 20 to 30 years of training in scientific research work which has given them rich practical experience and the ability to take charge. The second is that their age structure is too high, generally about 45 years. Thus, while mobilizing and encouraging these comrades to participate in industrial development we certainly must consider the characteristics of these comrades. It is no longer easy for them to take this step bravely and we must take into consideration their ability to bear the psychological burden of risks. We must strive to adopt a more relaxed "blurred transition" policy. For example, the Shanghai Institute of Optics and Fine Mechanics is now implementing "based at the research institute, wages paid by the jointly-run plant," "if a jointly-run plant is successful they can continue to work there, if it fails, they can return," and so on. These things embody this type of policy. However, in dealing with many concrete problems in actual work, we should try to make sure that they do not feel they have been driven out and do not fear that their path of return will be cut off. We should use the "water into the canal" method to deal with all concrete problems in order to benefit encouraging even more S&T personnel to participate in high technology industry development.

Third, on creating an equal competition environment in China and formulating policies to protect Chinese high technology industries.

Development of high technology industries cannot be detached from markets and with markets there is sure to be competition. There is intense competition within China and even more intense competition internationally. In China, competition is a good thing and can improve quality and reduce costs. Anyone with good quality products at low prices can take over a market. This is not the situation in many areas of China at the present time, however. Thus, the relevant leading state departments should formulate the necessary laws and regulations to assure an equal competition environment and protect the development of high technology industries.

For international competition, the most troublesome thing for many S&T personnel in the development of high technology industries is attacks by imports. When some high technology products cannot be produced in China, foreign countries fight to raise prices, but as soon as we begin to make them foreign countries fight to shave prices. When some units within China import in large quantities, it can bankrupt many enterprises in China which produce high technology products. This type of situation has already appeared in the microelectronics and other realms. Thus, we hope that the relevant leading departments of the state can formulate policies which stipulate that imports should cease of all high technology products which can be produced in China and whose quality meets standards, or they should stipulate high tariffs to restrict imports in order to protect the development of Chinese high technology industries.

Role of Institutions in Absorbing Imported Technologies

40080185b Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 2, Mar 89 pp 14-18

[Article by Hu Jiexun [5170 0094 1053] of Zhejiang University: "On the Role of Institutions of Higher Education and Scientific Research Units in Digesting, Absorbing, and Innovating Imported Technologies"]

[Text] Abstract: This article suggests that institutions of higher education and scientific research units have been the primary force in digesting, absorbing, and innovating in regard to technology imports in China in recent years. They have the necessary personnel of all types and extremely great enthusiasm. At the same time, their full complement of disciplines and comprehensive advantages have turned institutions of higher education and scientific research units into base areas for digesting, absorbing, and innovating via integration with importing plants and manufacturing plants, establishing base areas in special zones, transforming imported technologies, and so on.

Absorbing, digesting, and innovating are the keys to success or failure of the results of technology imports. Work to develop them is extremely weak. It would appear that institutions of higher education and scientific research units, China's main forces in scientific research, are cut off from digesting, absorbing, and innovating work. For technology imports, taking advantage of the role of institutions of higher education and scientific research units in digesting, absorbing, and innovating is extremely important work we face.

I. The Necessity and Urgency of Developing Absorping, Digesting, and Innovating

Importing digesting, absorbing, and innovating are essential links in successful technology importing. Among them, digesting, absorbing, and innovating have special statuses. Japan succeeded by relying on technology imports. Their technology imports from 1950 to 1978 totalled about $20 billion for about 30,000 imported advanced technologies, which allowed them to catch up quickly with advanced world levels to become a Western economic superpower second only to the United States. China's total imports between 1950 and 1979 were about $14.5 billion, and imports of technologies and equipment had surpassed $20 billion by 1984. We can see that China spent no less than Japan, but our results are far poorer than Japan's. Japan's success with technology imports was not due to the scale of importing, but instead to effective digesting, absorbing, and innovating to gain technical advantages and convert them into technologies for export. Inadequate digesting, absorbing, and innovating in China still prevent us from throwing off our backward technology situation.

Theoretically, imports are merely one measure. The ultimate goal is to increase one's own technological development and economic strengths. This goal can be reached only by digesting, absorbing, and innovating and producing technologies within one's own country. Focusing on importing while neglecting digesting only expands existing production capacity and causes dependence on foreign technology. It also can lead to weaker growth in domestic capacity for technological development.

Concretely speaking, the necessity and urgency of digesting, absorbing, and innovating work are manifest in these areas:

A. Digesting, absorbing, and innovating are essential conditions for avoiding redundant imports.

Redundant imports waste much foreign exchange and allow foreign businesses to profit. They inhibit rational deployment of associated construction within a country and full utilization of its manufacturing capacity. However, the results of simply relying on the usual administrative and economic measures to control redundant imports are less than ideal. The main cause of redundant imports is inadequate digesting, absorbing, and innovating. Market demand often cannot be satisfied by importing one set of equipment, so if a nation cannot produce suitable equipment itself, people with authority and foreign exchange must make redundant imports. Redundant imports can be prevented only by digesting,

absorbing, and innovating for immediately providing excellent domestic-made technologies and equipment.

B. Practice has shown that without digesting and absorbing, imported technologies may be unable to play their roles fully. In contrast, Japan's experience is that producing imported technologies domestically by digesting and innovating generally can raise efficiency more than 30 percent over original levels. Moreover, technologies themselves continually develop and change, and the pace of technical innovation is getting faster. This gives imported technologies an aging quality. Without digesting and innovating, very advanced imported technologies become outdated over time. Foreign countries often export second and third current technologies, while sealing up first current technologies. Thus, without digesting and innovating, we can only crawl along behind others and never catch up with advanced levels.

C. Digesting, absorbing, and innovating are important ways to improve scientific research levels and get a quicker grasp on technical progress.

Digesting, absorbing, and innovating imported technologies can greatly accelerate progress from basic research on through development and production. Digesting and innovating involve standing on another's shoulders, starting at a high point, and making fewer mistakes, and can enable catching up quickly with and surpassing advanced foreign levels. The goals of most of China's scientific research projects at the present time are pitched at foreign levels of the early 1980's, and many imported technologies themselves are at this level. Digesting and absorbing these technologies can raise the starting point for China's scientific research, save considerable scientific research expenses, accelerate our progress in grasping new technologies, and form our own technology systems. Inadequate attention to digesting and absorbing separates imports from scientific research within China. The starting point of scientific research would be low and it would increase the disparity between Chinese and foreign technology, which in turn would inhibit growth of scientific research in China.

D. Digesting, absorbing, and innovating are effective ways to increase foreign exchange earnings capacity.

The new technological revolution has grown beyond the years when one could depend on resource advantages to increase foreign exchange earnings capacity. The proportion of technologically intensive products on international markets increases daily. Improvements in foreign exchange earnings capacity are possible only by fighting for technological advantages. Importing without digesting merely allows imported technologies to take over domestic markets. Digesting and innovating are essential for exporting patents and technical secrets and enabling products with technological advantages to corner international markets.

E. Digesting, absorbing, and innovating are strategic ways to strengthen the independence of China's S&T and economy and form our own technical systems.

Foreign businesses often are concerned with leaving defects in key equipment and key technologies when exporting technologies to make it hard for us to leave their control. Importing without digesting inevitably causes reliance on technology exporting countries, control by other parties, and a loss of technological and economic independence. For the past few years, we ineffectively digested many imported items, spent considerable foreign exchange and relied on imports to get by. If we do not strive to digest them and eliminate our reliance on imports, they can become a heavy burden.

II. The Important Status and Role of Institutions of Higher Education and Scientific Research Units in Digesting, Absorbing, and Innovating

A. In looking at the goals of digesting and absorbing in all sectors, institutions of higher education and scientific research units should be a main force in digesting, absorbing, and innovating.

User plants, manufacturing plants, and scientific research and education departments all have their goals for digesting, absorbing, and innovating. The goal of user plants which import technologies is to digest applications, meaning to grasp the functions of imported technologies and equipment and strive to bring them up to projected indices. They often have no clear and effective model for their own production tasks. The goals of manufacturing plants should be to copy models and innovate. Viewing actual conditions in Chinese enterprises, however, with the exception of a small number of large and medium sized enterprises, most medium-sized and small enterprises have no special R&D organs because they lack the necessary S&T personnel of all categories with rather high levels. Given the added lack of capital and their own original low technical levels, their only goal is to copy. For systemic reasons, large enterprises have no urgent need for technical progress. Thus, manufacturing plants frequently do not make innovating their own goal.

Institutions of higher education and scientific research units have worked on R&D for a long time and their scientific research personnel have a keen interest in new technologies. They are rich in innovative spirit and are not satisfied to grasp existing technologies. Their goals truly are to digest, absorb, and innovate. Some digesting and absorbing work which involves many levels and plays a significant role depends mainly on them for completion.

B. Viewing the enthusiasm of all sectors for digesting and absorbing, institutions of higher education and scientific research units should be the nucleus of digesting, absorbing, and innovating.

User plants which import technologies start with their own interests and generally have no urgent need to copy

models and innovate. Copying would only deprive their imported technologies of their monopoly status, and innovation would make their original technologies lose their advanced qualities, train their counterparts, and thereby affect their economic income. Thus, user plants are usually unenthusiastic about absorbing and extending and are unwilling to provide prototypes to other departments for R&D. To copy imported equipment and produce key components, manufacturing plants need only small amounts. They are afraid that there is no market for domestic production and that they will not be compensated for trial development, so their enthusiasm for digesting and innovating also is low.

Institutions of higher education and scientific research units are extremely enthusiastic about digesting and innovating new technologies and training the various types of personnel required to develop new technologies. They have large numbers of special personnel with rich R&D experience. These people are extremely sensitive to advanced technologies and work at innovating. With reforms in the scientific research system over the past few years, they have gradually clarified their goals for serving economic construction and are enthusiastic about extending and applying their scientific research achievements, so they have the initiative to extend their achievements into all industries and related fields. It is apparent that institutions of higher education and scientific research units are the nucleus of digesting and extension.

C. Viewing trends in S&T development, China's institutions of higher education and scientific research units should be base areas for digesting and innovating.

Modern S&T development tends toward a high degree of comprehensiveness and specialization. Closely coordinated basic, applied, and development research are usually required to assimilate new technologies. Many disciplines and specializations also must be coordinated. Thus, digesting and absorbing are very technologically intensive and much more complex than importing. After World War II, Japan put most of its research forces into absorbing and transforming imported technologies and tried to "Japanize" imported technologies. The range of specializations in R&D departments in Chinese enterprises is rather narrow and they have no basic and applied research personnel, which often makes it hard for them to digest and absorb imported technologies independently. In contrast, institutions of higher education and scientific research units generally have all types of basic, applied, and development research personnel and a full complete of most disciplines. They have the advantage of being comprehensive and concentrating China's primary scientific research forces, so they should become base areas for digesting and innovating.

III. Ways for Institutions of Higher Education and Scientific Research Units To Promote Digesting and Absorbing

Although China has special organs responsible for importing at all levels, we have no special department to organize digesting, so apparently those who import are those who digest. Since the 1970's, more than 70 of China's imported items were direct production equipment imported by user plants. Fewer items were imported by manufacturing plants and even fewer by institutions of higher education and research institutes. Moreover, prior to S&T system reforms, the enthusiasm of S&T personnel to digest and absorb was not high and they could not treat this work as an important scientific research topic. Thus, digesting and absorbing are detached from S&T development in China and institutions of higher education and scientific research units are cut off from digesting and absorbing. A sample survey of 620 items imported by China between 1973 and 1986 shows that scientific research units helped enterprises digest and absorb in fewer than 2 percent of the cases. After reform of the scientific research system, institutions of higher education and scientific research units are enthusiastic about digesting and innovating but they have neither the capital to import technologies and equipment nor a manufacturing and production capability, so they seldom are involved in digesting and absorbing. Thus, it is extremely important that we explore ways for institutions of higher education and scientific research units to promote digesting and absorbing and assure that this work proceeds smoothly.

A. Strive to develop horizontal integration of institutions of higher education and scientific research units with importing plants and manufacturing plants to promote digesting and absorbing.

Digesting and absorbing are comprehensive work which covers a broad area. While institutions of higher education and scientific research units have an important status in this, they find it hard to proceed when detached from user plants and manufacturing plants. A major effort to develop horizontal integration which includes scientific research, education, production, utilization, and other areas is an effective way for faster digesting and absorbing by institutions of higher education and scientific research units. Integration can concentrate advantages in all areas related to imported technologies to cover problems with technologies, equipment, and capital, and it links the interests of all parties, which can compensate organizationally for the past situation of hardships for plants in digesting and absorbing and for research departments in extending. Integrated digesting can coordinate import digesting with R&D in China, which promotes digesting and raises research levels. It is best if integrated digesting is combined with imports, with institutions of higher education and research institutes assisting enterprises in research on technological choices prior to importing, and to assure smooth progress in later digesting and innovating. Integrated digesting, particularly after joint formation of integrated scientific research and production bodies and including investments by scientific research departments, ensures that someone will digest and absorb after importing and that scientific research organs can carry out digesting and innovating work.

The results of joint digesting and absorbing by enterprises, research institutes, and institutions of higher education are very good. The Soviet Union requires that applications for technology imports be made jointly by research, design, and production departments to administrative departments. The United States Government encouraged and consolidated cooperation between universities and industry and formulated an industrial relationship plan to establish loose and rather long-term linkages between universities and industry. They also provided subsidies for this type of cooperation. China also has many successful examples of digesting and innovating by institutions of higher education and scientific research units in conjunction with enterprises.

B. Establish digesting, absorbing, and innovating base areas in special zones and S&T development zones.

Several special zones, high technology development zones, scientific demonstration zones, and other things have appeared in all areas in the past few years. These regions are often intellectually and technologically concentrated and are windows for China to explore, absorb, and broadcast the world's newest technologies. The state also has many preferential policies for these regions. Thus, they are the vanguard of S&T development in China and have conditions conducive to building them into pioneering imported technology development zones. Institutions of higher education and research institutes can independently or jointly establish their own administrative organs in these regions to turn them into base areas for digesting, absorbing, and innovating. The governments of S&T development zones also can organize S&T development companies to assume responsibility for organizing planned digesting, absorbing, and innovating by institutions of higher education and research institutes in conjunction with enterprises in that region. The Hanjia Hu S&T Development Company established jointly by Zhejiang Province and the State Science and Technology Commission in 1989 is one example of this type of organization. The Zhejiang Provincial CPC Committee allocated special funds to support institutions of higher education and S&T to develop an export-oriented economy in the Hangjia Hu region. This type of S&T development company permits utilization of forces in many institutions of higher education and research institutes and thus provides rather substantial benefits, and they can complete digesting, absorbing, and innovating quickly and transfer them to other regions.

C. Change technology import structures, gradually change from importing for the goal of expanding production to importing for the goal of studying technologies.

Most of China's technology import items now involve only imports of hardware and equipment, and the proportion of patents, technical secrets, and other software is too small. Equipment lags behind the corresponding manufacturing technologies in the life cycle of technology as a whole. Simply importing equipment for use in production leads to an aging import structure and the relative urgency of digesting, absorbing, and innovating is not great, so institutions of higher education and scientific research units are unwilling to become involved. China must have an R&D foundation and enormous matching technical forces if we dare to import technologies in their emerging period. Institutions of higher education and scientific research units can play a rather significant role because of their wide influence and big results. In the future, the state should organize and support scientific research units and institutions of higher education which lack a foundation in a planned manner in importing advanced technologies which are in the emerging stage of R&D.

Japan's initial experiences in importing, digesting, and absorbing steelmaking technologies should serve as an example. At the time, they noted the rapid developments, high cost, and major risks involved in steel refining technologies and felt no sense of urgency to import advanced steelmaking technologies into plants. Instead, they used various methods to import two sets of equipment. One set was provided to institutions of higher education for use in training in this area and for use by management and research personnel. The other set was provided to research organs for research purposes, assuring that they would lead in this area in the future and that advanced technologies in this area would be used for their own purposes in the future, and achieved the best results.

IV. Acknowledge and Use the Role of Institutions of Higher Education and Scientific Research Units To Digest and Absorb

Making full use of the role of institutions of higher education and scientific research units to digest and absorb requires policy formulation to protect and encourage digesting and absorbing and changes in peoples' ideology and understanding.

First, we should work to change the situation as quickly as possible of importing only equipment and not soft technologies. Japan also shifted from mainly importing complete sets of equipment to focusing on importing software technologies during the process of technology importing. Software imports can speed up the pace of digesting and absorbing and create conditions to use the role of institutions of higher education and scientific research units to digest and absorb because digesting and absorbing this type of technology usually requires their participation. The state should adopt effective measures so that generally no complete sets of equipment are imported when problems can be solved by technology imports. Importing units should formulate plans in advance for digesting and absorbing all necessary imports of complete sets of equipment to truly integrate imports and R&D in China.

The state and regions should establish digesting, absorbing, and innovating funds for use in the form of low-interest or interest-free loans to encourage institutions of higher education and research institutes to

integrate with manufacturing plants for joint management of research, digesting, development, and production. The state should impose higher import taxes on redundant import items. The relevant departments in enterprises which fail to implement digesting and absorbing work and adopt ineffective measures after importing are responsible for intervening to implement tasks for digesting and absorbing this technology or equipment in other departments, and the original importing unit has the obligation to provide the required technical information and data. At the same time, the state should instruct the relevant departments to study and suggest within a fixed period of time several technologies which have a significant relationship to current economic construction and which urgently require importing and digesting to encourage and subsidize institutions of higher education and scientific research units in importing this type of imported software and technologies and in digesting and innovating. We should focus on assuring that institutions of higher education and scientific research units can import instruments, equipment, and materials neede for R&D, provide better scientific research facilities, and meet the need for digesting and innovating.

Finally, when relevant departments appraise and examine import items, they should make the ability or inability to digest and absorb the primary criterion for approving the import item. Enterprises which themselves do not have a special R&D department should request that corresponding institutions of higher education and scientific research units jointly carry out digesting and absorbing. First rights over imports should be given to items jointly imported and digested by institutions of higher education, scientific research units, and enterprises.

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Speeding Up the Absorption of Imported Technologies

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[Article by Xia Guofan [1115 0948 5672] of the 608 Institute, Ministry of Aeronautics and Astronautics: "On Policy Measures for Technology Importing, Digesting, Absorbing, and Innovating"]

[Text] Abstract: This article discusses the theories and patterns related to selecting, digesting, absorbing, and innovating imported technologies. It proposes integration of technology importing with technical transformation, technology importing with technology exporting, and technology importing with personnel importing. It also proposes establishing import mechanisms for macro effective regulation and micro self-control.

Technology imports are one way for a nation to save money and time in scientific research and trial manufacture to propel S&T progress and economic development as quickly as possible. As the pace of China's opening up to the outside world has speeded up, we have made enormous advances in technology importing work. China imported over 14,000 technologies, key equipment, and production lines during the Sixth 5-Year Plan at a total cost of $10 billion.

Imports of advanced technologies have brought gratifying changes to China's industrial situation and moved us into the world ranks of major producing countries in certain realms. By the end of 1987, 45 percent of the total volume of exports from the electromechanical industry were realized via operationalization of imported technology items. However, our importing work still exhibits phenomena like too many people being involved in foreign dealings, blind deployments, redundant imports, emphasizing imports but neglecting digesting and absorbing, and detachment from domestic production. To speed up the pace of technology importing, promote S&T progress in China, raise production levels, strengthen our own capacity for development, and accelerate economic construction, we must adhere to the principles of focusing on importing software technologies and integrated imports of the required key equipment by scientific research and production units, digesting and absorbing, and so on. In concrete terms, we should adopt the following measures:

I. Use the Concept of Integrating S&T Progress and Economic Results To Select Appropriate Technology Imports

Selection of imported technologies must be guided by the ideology of integrating S&T progress with economic results, and it should make high technology the guiding direction and appropriate technologies the main factor in determining the concrete levels and content of imported technologies according to our own conditions.

A. Importing large scale production industry technologies. This mainly involves the need to readjust industrial structures and establish emerging industries in importing modern product technologies and production technologies, and includes imports of applied technologies in the area of operation and maintenance, method technologies in the areas of design and techniques, and basic principle technologies. Concern for imports of production technologies for key basic components is especially important, and sufficient attention should be given to key special materials. We should import and develop to place them into large-volume production and form scale economies.

B. Importing equipment and modern technologies. Certain key technical equipment with a high technology content and large added value can be imported for "marrying" to production lines based on Chinese-made equipment. This is particularly true for certain high precision, special-purpose, numerical control, complete sets and other high level equipment and technologies which are urgently needed, and there should be focused imports.

C. Actively and selectively import high technology. Modern high technology touches on a broad S&T forward position zone. Given China's national conditions, we can only adopt a policy of limited goals, focus on key breakthrough points, give hot pursuit, move near forward positions, take aim at the newest achievements in world S&T development, set our sights on incisive S&T in the developed nations, break down "technology barriers," selectively import microelectronics technologies, electronic computer technologies, new materials, artificial intelligence technologies, and other high precision key technologies with major applications prospects in industry, and use them to establish high technology industries and reduce the S&T gap between China and the developed nations.

D. Import large quantities of appropriate technologies. Appropriate technology systems refer to technologies higher than existing technical levels in China but still considered to be advanced here. This also means importing many applied technologies adapted to development of the commodity economy and the export-oriented economy which conform to China's S&T levels, industrial foundation, resource conditions, and technical capabilities for rapid conversion into forces of production to generate economic benefits and gradually create the conditions for shifting to high technology.

E. Appropriate imports of management technologies. Modernized management and S&T progress determine the level and speed of development of forces of production. Since we want to import advanced technologies from foreign countries, it is even more important that we be concerned with how to import scientific methods and management experiences from foreign countries to push S&T forward. This mainly involves importing theories, concepts, and scientific management methods for use when formulating industrial S&T policies, S&T system reforms, and raising management levels, and importing experiences in production technology management, quality control, marketing, and other areas to integrate them with our own effective scientific management methods and to innovate and improve them.

II. Digest and Absorb Imported Technologies in a Planned and Gradual Manner on the Basis of "Four Levels"

We must select import items which represent industrial or regional technological development levels and conform to medium and long term S&T development goals and organize breakthroughs in key areas in a planned and gradual manner on the basis of the four levels of "placing into operation and producing—domestic production of components and materials—equipment development—development and innovation" for overall improvement of S&T levels in China.

A. Going into operation for production should make imported technologies form effective and rational technological systems within China and rapidly place them into production. This requires establishment of organizational systems for achieving operation and production which include design, construction, production, supplies, S&T, and power drives, arranging technical organization measures according to network plans, guaranteeing primary and auxiliary equipment, and concurrent startup of measures to deal with the three wastes [waste water, waste gas, and industrial residues]. After going into operation, we should rapidly form production management systems with senior engineers, dispatch and workshop directors, shift leaders, and even primary operators to achieve safe, stable, and balanced development after startup to rapidly attain a capacity for economically producing large quantities and design.

B. Shift to domestic production of components and materials. We should consider areas which we should shift to domestic production first, which areas we wish to shift to later, and which areas we do not have to shift to domestic production from the perspectives of the objective laws of commodities and major world cycles and substitute components which we can produce for those components which we cannot produce to integrate "self-development" with "buying abroad" with dominance by "self-development" to avoid restriction by others and dependence on imports of scattered components and raw materials to sustain production. To shift to domestic production, we must grasp metallurgical technologies for the special materials used in prototypes to smelt, forge, and cast Chinese-made materials and blanks. For materials which cannot yet be developed and produced in China, we can select approximate domestic materials as substitutes based on the properties of the materials used in the prototype. We should use testing and debate to grasp working conditions and stress levels of the various components in the prototypes and with a prerequisite of no reduction in design requirements, we can transform the structures of certain components to conform to enterprise technical levels. We can use defects revealed

during startup and operation to make rational improvements in component structures. Or, we can try adopting new technologies and select new materials to overcome problems with the required degree of high precision to update our techniques a generation and raise technologies a generation. We should use comparative measurements of prototypes, mixed installation in prototypes, and other methods for key components to inspect the conformity of Chinese-made components with the prototypes.

C. Equipment development. This involves importing product technologies to meet special requirements for high precision, a high degree of cleanliness, and so on. It often requires technologically intensive equipment or developing a certain amount of technical equipment on our own. If we lack our own development capacity we will have technical hardware but will still be unable to truly grasp new technologies. This is particularly true for core technologies and sensitive technical equipment, which we must develop. In equipment development, we should use an "integrated" organizational method to dissect integral equipment and matching arrangements on the basis of components, assembled components, raw materials, and systems at other levels to organize broad-based horizontal cooperation. We should apply new technologies, new techniques, and new materials to attain intelligent control functions, flexible information functions, energy-saving motive power functions, lighter structural performance, and softer manufacturing functions for equipment development.

D. Development and innovation. We must import on the basis of existing R&D and develop and innovate by using imported technologies as starting points. Concrete innovation programs can enable the application of all or parts of a technology in similar old products or other products for obvious improvement of their technical levels compared to previously. Or we can use imports of product technologies for certain specifications as a basis for partial improvements or appropriate reconfiguration, extend and develop products with other specifications such as creating special products from common products, land-based products from space products, and civilian products from military products to achieve multiple varieties of the same device. Or we can summarize mature experiences with various imported technologies and add our own pre-research achievements to develop new technology products with changes in structures and materials mixtures, substantial improvements in performance and useful life, new breakthroughs in principles and mechanisms, and which conform to China's resource conditions and traditional technological advantages to truly make imported technologies a "catalyst" in China's economic and technological development and take our own development path.

III. Integrate Technology Imports and Technical Transformation To Promote a Shift From Traditional Industries to Modernization

China's huge traditional industrial system is a primary force in our national economy as well as a basic position for our continued advance. Equipment in these traditional industries is outmoded, however, and most enterprises have high consumption, low efficiency, and a lack of competitiveness in product performance and prices. Scientific and quantitative analysis of 5,130 types of primary products from the former Ministry of Machine Building Industry indicates that only 18.9 percent were equivalent to advanced foreign technological levels of the late 1970's and early 1980's while 42.8 percent were equivalent to the early 1970's. Thus, one urgent task is to use technology imports to promote technical transformation in traditional industries and to push overall technological levels in the machine building industry and natural defense and military industries up to a level near that of the developed nations in the late 1970's and early 1980's before the year 2000.

To assure close coordination of technology importing with technological transformation, we should make industrial policies, technical policies, and equipment policies the foundation for adhering to the principle of different levels and industrialization and take the route of "new birds in old cages." Large and medium-sized enterprises should use their original plant buildings, facilities, technical lines, and structures as a foundation for selective imports of microelectronic technologies and computer control technologies for targeted transformation of old equipment in order to achieve significant improvements in processing precision and production efficiency. We also should make appropriate imports of special-purpose equipment or precision processing equipment which play a deciding role in improving product quality and reducing consumption and match them with existing production lines to achieve a take-off in product quality. Medium-sized and small enterprises mainly should import applied technologies and precision machine tool equipment, and they should adopt single board computers and microprocessors to improve equipment performance and product quality.

Technology imports should begin with research on the need to readjust industrial structures and product mixes, satisfy the need for product renewal and replacement in traditional industries, and target imports of product technique technologies and manufacturing technologies. Particular attention should be given to imports of technologies for blank manufacturing, basic components, basic techniques, important special materials, and other basic technologies. They also should digest these technologies in their own technical systems and embody them in the finished products they produce themselves to raise the performance and useful life of existing products to new levels and increase the capacity for market competition and international competition.

IV. Implement an Import Strategy Which Combines Purchases and Sales for Active Development of Technology Exports

Adherence to using exports to develop imports and buying in order to sell can create a road for "technology

imports—digesting and absorbing—exporting for foreign exchange—expanding imports." Thus, we must clarify the relationship between technology imports and technology exports and combine technology imports with active organization of technology exports.

Technology exports should be focused on mature industrialized technologies and be concerned with exports going through a process of digesting, absorbing, and innovating to become new technologies. We should target different nations and regions at different levels for technology export business, avoid areas where they are strong and attack areas where they are weak, and target different technology structures to open international markets. We should use software technology exports to ship out equipment, products, and labor services and increase the foreign exchange earnings rate. To protect our independent technical tricks of the trade, we must adhere to the principle of re-exporting after development inside China. Items for which China will not have the conditions to develop first within a short time because of capital, technical, or equipment reasons can be exported selectively but we must have technical protections in foreign countries, adhere to the principle of reciprocity and mutual benefit, and try to exchange high technologies which are hard to buy in international technology markets.

Out-shipments of intellectual and labor services are one form of technology exports and we should bravely open up personnel markets to move S&T personnel from sectors and areas with personnel surpluses into international markets to make good use of their talents. This could earn foreign exchange for the state and give us familiarity with the development environment in foreign countries during technical services.

To encourage the initiative of enterprises and business units for technology exports, industries and regions can select basic level units with the proper conditions and give them direct management rights over technology exports, permit the enterprises to establish "S&T windows" in foreign countries, enable them to obtain the newest information in international markets, and make technical commodity development catch up with world currents to adapt to the competitive environment in world technology markets. Enterprise units should increase their knowledge concerning export competition, and they should discuss the possibility of directly importing items to achieve a balance between foreign exchange income and expenditures while they are doing feasibility research concerning the imported technology in order to select first those items which can earn foreign exchange for importing and increase our international competitiveness. We should formulate policy measures to encourage technology exports and adhere to the principle of allowing parties which earn foreign exchange to use it. Deductions of foreign exchange should give preference to technology exporting units and income from software exports should be exempt from income taxes. Electromechanical products exported along with shipments of technologies should receive special interest-bearing loans or purchaser credits for state-supported exports of electromechanical products. Technology trade organs and technology trade companies should be set up in foreign countries on an industry or regional basis to form a marketing and agency network for technology exports and open up channels for the flow of technologies into international markets, strengthen linkages between China's S&T circles and foreign industrial circles to make Chinese technology take a large step toward the world and create the material conditions for further expansion of technology imports.

V. Stronger International Cooperation Should Be a Major Policy for Technology Importing Work

More intense competition in the S&T realm should be accompanied by stronger international cooperation and coordination of S&T. S&T cooperation relationships have become an important basic content of modern international relations. In our technology importing work, we should make equality and mutual benefit the foundation for developing international cooperation with all parties and in multiple forms.

A. Joint design, cooperative development. China participates in the entire process of design and development and we have the capacity for independent design. Protect decision making rights over technologies, prevent dependence on technology exporting nations, and raise our own status in international competition. To promote broader and more intensive growth in joint design and development, we can consider allowing some markets in China for certain high technology products to implement "import substitution" measures and strengthen the attractiveness of advanced foreign technologies, but we should stipulate a specific proportion for domestic sales to prevent "cooperation" in which foreigners provide the technology while China provides the market form.

B. Joint investments for building plants, integrated management. Focus on jointly-run high technology companies, high technology laboratories, and scientific research organs. For example, a foreign party can provide part of the equipment as an investment, which absorbs technology and also carries in some technologically advanced equipment. We should, however, do feasibility analysis, economic comparisons, technical selectiveness, and applications research for the equipment invested to prevent excessively high manufacturing costs and outdated equipment, and to place our sights on S&T cooperation at the forefront of science.

C. The "three provisions and one subsidy," integrating industry and trade. This refers to the method of providing materials for processing, providing blueprints for production, providing components for assembly, and subsidizing trade for directly grasping new foreign technologies. By having stable quality, supplying goods on time, and establishing a reputation we can continually expand the scope of the "three provisions" and even develop core components so we continually absorb new technologies provided by our counterparts. This is an

initial form of international cooperation and a concretization of the "two heads in foreign countries, significant importing and significant exporting" advocated by Comrade Zhao Ziyang.

D. Software imports, linked interests. When building plants, the Chinese side provides the inputs while the foreign party provides "invisible capital" shares with their high technology and marketing channels. Shares are determined according to the foreign exchange earnings value of the technology and the extent of cooperation with dividends paid according to shares and both parties being jointly concerned with investment returns. It is best, however, when the foreign party's technology accounts for about 20 percent of the profits, and it should not exceed 30 percent for high, precision, incisive, rare, superior, or slanted technologies.

VI. Importing Foreign Personnel Should Be Given Greater Importance

S&T personnel are the carriers of technical knowledge. Their role cannot be compared to equipment, products, data, or blueprints because personnel imports are less expensive than importing software or material technologies, produce results quickly, and provide optimum results. Thus, importing foreign S&T personnel has become a focus of world competition and hiring professional managers from outside a country has become an international trend. We must utilize officials, civilians, and all types of international organizations as channels to make use of the role of diplomatic and consular personnel stationed abroad, overseas Chinese service organizations, and all types of academic bodies in importing personnel from foreign countries and boldly import S&T personnel who are familiar with foreign technology.

A. Clarify that the focus of personnel imports should be placed first of all on engineering and technical personnel and on economic management personnel from among overseas Chinese and foreign citizens of Chinese origin. More than 20 million Chinese now reside in various nations of the world and there are several 100,000 S&T personnel with considerable talent. Many are as innocent as newborn babies in their patriotic yearnings, and we speak a common language, so S&T personnel in China can learn from them. Second, we should give attention to importing retired foreign personnel who are full of vigor and technically proficient. Their remuneration could be less than that for on-the-job personnel, which would facilitate imports somewhat.

B. Match Technology Imports With Personnel Imports. This mainly refers to technology exporting units which assign management cadres and engineering and technical personnel for technical consulting and special technical examinations concerning patent production and to aid in solving key technical problems. Technology imports should be integrated with sending talented Chinese S&T and management personnel to counterpart units for study and training, utilize experimental conditions in foreign countries for experimental research, come into contact with new equipment and absorb new technologies from foreign countries, and take advantage of the intellect of foreign experts in to develop Chinese intellectual resources, train S&T staffs capable of digesting and absorbing advanced foreign technologies, and flexibly use "transfer personnel" for imported technologies based on our national situation.

C. We can permit primary management by foreign experts of joint research, joint investment, and joint management enterprises. This could eliminate the fetters of the old system and perplexing relationships, and it could make foreign businessmen more concerned with enterprise product quality, technical progress, and economic results, enable personnel in China to study their advanced technology and management experience, and make a comprehensive improvement in the technical and professional qualities of Chinese personnel.

VII. Establish an Import Mechanism With Effective Macro Regulation and Micro Self-Restraint

A. We should establish management organs for overall planning and coordination of technology imports on the basis of industries and regions and formulate an overall development strategy for technology imports and a joint import program according to the overall principles for development of the national economy, and unify comprehensive evaluation index systems and scientific evaluation methods for import results. Clarify the scope and range for protecting the short term and restraining the long term, and for supporting the best while restricting the worst, encourage imports of advanced technologies, export technologies which earn foreign exchange and basic public purpose technologies, control imports of technologies involving conventional technologies, production applications, and delayed results. Perfect industrial S&T information networks, strengthen our S&T information transmission system, implement "multi-element export-oriented" tactics, guide enterprises to select transferring parties for technologies which have a high self-ownership rate and low foreign matchup rate, select transferring parties to support production within China and take responsibility for resale, and select transferring parties with fair prices and superior conditions. We should do good work in balancing foreign exchange and domestic capital and coordinate a balance within importing work. We should be concerned with effective tracking and survey systems for technology imports, and establish archives, information, and databases for technology imports for survey research. In summary, technology imports should be integrated with protecting Chinese industries to unify enterprise technology imports with overall state, industry, and regional technology import plans.

B. We should do comprehensive, systematic, and intensive feasibility research and use the extent of technological progress of imported items to apply and extend value, digesting, and absorbing programs, for comprehensive debate concerning sources of resources within

China and the matching conditions, make comprehensive and long-term results and comprehensive technical, economic, and social goals the starting point, clarify that no hardware should be imported when software can solve the problem, and that those who import hardware technologies should import the key components and key equipment at key positions, and apply testing and control measures to assure quality. Complete pieces of equipment should not be imported when component imports can solve the problem. When importing a single unit is sufficient, we should not import complete sets to prevent short term and local behavior from deviating from long-term overall goals, and strive to make optimum selections and assure the correctness of policies.

C. We should formulate a set of encouragement policies to promote digesting and absorbing of imported technologies and stipulate clearly that imported items must attain a certain level of domestic production before construction can be examined and accepted. Technology imports to develop new products should attain a stipulated rate of domestic production before they can be examined and approved for operation. Domestic production items with good economic benefits and a high foreign exchange conversion rate should receive interest-free preferential loans and we can permit loan repayment prior to taxation at the present stage. When components, spare parts, and equipment basically meet foreign standards, foreign trade departments should cease or restrict imports. When our "products catch up to imports," we can use the foreign exchange originally needed for imports to supplement units which have made an effort to achieve domestic production and give them foreign exchange to repay their loans. When products developed through domestic production have not reached the batch production or trial marketing stages, they should receive exemption from product taxes or consideration in value added taxes. In addition, we should allow the cost of domestic production to be included in production costs and set aside a specific proportion from the profits as funds for domestic production at importing units, and personnel who have been awarded bonuses for their contributions to domestic production should be exempt from bonus taxes. The state should allocate appropriate subsidies for common technology items with high social benefits and a high bloodmaking capacity. We should protect domestic production of technology imports and innovation achievements, formulate the corresponding laws and regulations on dispersing imported technology achievements within China, and implement compensated transfers to attain "everyone benefitting from imports by one party" and thereby form a set of motive force mechanisms to encourage and guide digesting, absorbing, and domestic production.

D. We should adopt economic and organizational measures to promote horizontal integration of economic technologies. Technology importing, digesting, absorbing, and innovating are a comprehensive socioeconomic topic. We must break down departmental and regional boundaries, promote integration of primary equipment plants, auxiliary equipment plants, and component and raw materials plants, promote integration of scientific research units, manufacturing departments, and user plants, promote integration of national defense military industry and civilian industry departments, and use the "fully integrated" method to organize large scale socialist cooperation. Divide the ultimate technology products imported into certain links, standardized and unify, synchronize progress, and organize joint attacks on key problems. This is particularly true of major technology import items. We should use administrative measures and the corresponding policies to organize joint cooperation on an industry and national scale. Rely on the advantages of groups and solve major S&T problems at higher levels. In the future we should make participation of scientific research units in import work an essential condition for examining and approving items. Scientific R&D imports in particular should be the primary responsibility of scientific research units.

E. We should implement a contractual responsibility system for investments and a project input/output goal responsibility system. Bonuses should be given to all those people who make prominent contributions to import work. Economic responsibility should be sought for those whose irresponsibility in work causes mistakes in decision making. All persons who accept bribes from foreign parties and sell national interests should be punished in accordance with the law.

It also should be noted that the world's major economic powers have adopted strict technical secrecy policies which indicate that they want to seal off technologies from developing nations like China and have strategic intentions of maintaining discrepancies by means of prohibiting fulfillment of technology and equipment contracts and delaying examination and approval, formulating laws to protect intellectual product rights, revising principles for open information, and so on. Thus, we should be clear-headed, judge the hour, size up the situation, and use every possible mechanism for active importing of technologies. We also should reinforce scientific research and self-development and place our starting points on the basepoint of reliance on our own efforts.

Developing High-Tech Industry in Research Institutes

40080185d Beijing KEYAN GUANLI [SCIENCE RESEARCH MANAGEMENT] in Chinese No 2, Mar 89 pp 32-34

[Article by the Chinese Academy of Sciences [CAS] Shanghai Technical Physics Institute: "An Attempt To Develop High Technology Industries in Scientific Research Units"]

[Text] Abstract: The CAS Shanghai Technical Physics Institute is a research organ which focuses (75 percent) on applied development and research in infrared remote

sensing technologies. Over the past few years they have worked to use their own technical advantages and focused on extending and applying scientific research achievements, actively competing in international markets, selecting international cooperation (project) partners, and taking the road of developing high-tech industries.

In 1986, the CAS Shanghai Technical Physics Institute sent seven mid-level and advanced S&T personnel to the famous Japanese company Ceramic Kumagai Gumi, a world developer and producer of sensors (used as key components in intrusion alarms and other systems) for joint investment to establish the Shanghai Nisaila Sensor Co., Ltd. to produce and manage all types of sensor infrared light filters and other high technology products, and it has become a scientific research and production type Chinese-foreign joint investment enterprise in our scientific research system which can transfer technologies to joint investment enterprises. Some 95 percent of their products are exported for sale abroad and their reliance on technical progress has increased value and produced obvious economic results. The relationship between the two parties is solidified with a 50/50 share arrangement and there is a general manager responsibility system under leadership by a chairman of the board. This company has been confirmed by the Shanghai Municipal People's Government as an advanced technology product exporting enterprise.

The Shanghai Nisaila Sensor Co., Ltd. formally opened in April 1987 and temporarily borrowed an experimental building at the institute for full operationalization and production. Statistics for January through June 1988 show that it produced 210,000 PZT heat-tripped electrical sensors for use in burglar alarms (this was 2.1 times the 100,000 units stipulated for completion in the contract). It has produced 950,000, 6.5 μm frontal infrared blocking filters that are now available internationally from only a few technologically advanced nations of the world like the United States and others. More than 95 percent of these two products were exported for sale in foreign countries. This company has a staff of over 50 people and earned $640,000 in foreign exchange and $350,000 in net profits during the first half of 1988. The after-tax net profits may reach $13,000 per employee for the year, showing the strong vitality and obvious economic results of this high technology product entering international markets.

What role can the export-oriented economic body tried out by the CAS Shanghai Technical Physics Institute and the high technology products it produces play in increasing the institute's decision making capabilities? The Technical Physics Institute is working in these areas:

1. Faster Conversion of Scientific Research Achievements Into Commodities

S&T personnel at the CAS Shanghai Technical Physics Institute have felt deeply in practice that moving an item from stage-type scientific research achievements to a commmodity capable of competing in international exchange is a difficult conversion process, and the effort spent on the latter can be many times that expended on the former. Using the infrared light filtering technology inputs by the institute into the joint investment enterprise as an example, the various types of infrared light filters developed by the institute have been evaluated by colleagues as being at a leading status within China. Some products they developed for use as transparent windows have already been successfully used in satellites launched by China, but they use traditional techniques and "accept one per 10 or even one per 100," so they are extremely expensive, cannot be produced in large quantities, and cannot compete in international markets. They seized the opportunity and used imports of foreign capital to purchase some advanced technical equipment for cutting, grinding, polishing, slicing, and other things. They analyzed market information supplied by their foreign partner. They studied advanced management experiences in foreign enterprises. They relied on S&T personnel and production workers to conduct scientific experiments targeted on market demand and worked day and night for a whole year to eventually produce large quantities of 6.5 μm frontal infrared light filters equivalent to products from the United States' OCLI Company and at a price lower than theirs. Some 97 percent are being exported to Japan and their cost is just one-fifth the original figure. Output increased 100-fold and there have been significant breakthroughs in product quality. Thus, they cannot meet foreign demand even though they have started a third shift. To further expand production, they are now working on a second feasibility research report.

2. Faster Product Penetration of International Markets

Prior to establishing the Shanghai Nisaila Sensor Co., Ltd., the TGS heat-tripped electrical sensors developed by the Technical Physics Institute were sold to a West German plant which produces spectrometers, but they require only a few 10 sets each year for use as receiving components in spectrometers. However, there is an extremely brisk international market for large numbers of these sensors for use worldwide in intrusion and burglary alarm devices, automatic light switches, automated control systems, and other things. We are at a disadvantage, however, because we cannot meet buyers' requirements in products, quality, prices, quantity, delivery schedules, and after-sales service work. Even more important is that our long-term closed system, sluggish information, and lack of a special foreign marketing network and well-trained marketing personnel have prevented our own products from entering international markets.

After joint investment with the foreign party, they obtained a great deal of market and economic information from their counterpart and used the jointly-prepared feasibility research report F/S as a foundation for affirming enterprise production plans, clarifying goals, and targeting international markets. When signing the joint investment contract, they resolutely adhered to

our decision making rights over domestic and foreign product sales by the Chinese joint investment enterprise and opened a route for future self-entry into international markets. They also stipulated that for a few days after beginning, the foreign party should try to market products from the joint investment enterprise in foreign countries and assure that the enterprise can make profits of about 30 percent.

Of course, for a few years after beginning, some commercial profits must be paid to the foreign party, but it is converted to 95 percent in foreign exchange, and they have studied how their foreign partner sets prices in international trade, how payment conditions are negotiated, how to establish excellent relationships with customers, and other measures and methods. After a year of practice, they have understood market information for different periods and studied the "business classics" of some Japanese, but even more gratifying is that they have initially established their own marketing channels and customer networks. By the end of 1988 they had sold over 10,000 probes themselves in Hong Kong and other areas and laid a preliminary foundation for expanding their own exports. The Shanghai Technical Physics Institute used opportunities to send CAS S&T personnel abroad for study, participate in conferences and foreign exhibitions, and other things to spread a company prospectus and product descriptions to increase the name recognition of the enterprise and open up new international markets.

3. Study Foreign Management Experiences, Improve Enterprise Management Levels

In joining with a foreign party to establish a joint investment enterprise, the institute first studied foreign management methods and made major reforms in hiring systems. Workers were recruited from society through testing and selection, and a contract system was implemented. They transferred technical personnel from the institute, formulated plans, implemented a recruiting system, and permitted dismissals and resignations to encourage the breakup of the "iron pot" in personnel circulation. Second, there was strict management. Based on the Japanese party's methods, working personnel must work at a full load, fast pace, and high efficiency. Working time cannot be stacked up and things unrelated to production cannot be done. Party group organizational activities and so on are held during free time. All enterprise employees are clear now about the content of their work each day and that the per worker value of daily output must exceed the 450 yuan index. Thus, they are quite fearful of power outages and water cutoffs because shutting down for 1 day causes the enterprise to lose more than 20,000 yuan.

Quality management is a major link in enterprise management. Comrades from the Technical Physics Institute who participate in enterprise work have applied the regulations and methods of Japanese enterprises for reinforcing quality management, and they have established strict management systems for materials deliveries, production, semi-finished products, inspection, storage, packaging, shipping, and all other links. These things quickly converted the products of scientific research into commodities which can pass quality inspections. Once, while testing sensors, an employee accidently dropped a component being measured from the test rack onto the table. Its performance was still good after re-inspection. The Japanese general manager standing nearby clearly pointed out that this product could not leave the company and should be handled as a waste product because it had hidden internal defects and its performance would degrade after long-distance shipping to the United States and other customers, which would affect the reputation of our enterprise. They also requested that the Chinese side draw inferences about other cases from this instance in focusing on quality. Another example is quality inspection of infrared light filters. The foreign party has an extremely strict set of inspection methods and procedures. For example, they must withstand scratching by a special lead pencil with a hardness in excess of 7H without leaving traces on the surface of the plated film. After cutting the large piece into smaller ones, a highly adhesive rubber band is stretched with force over both surfaces of the filter and no minor film parting phenomena are permitted, and so on. It was only after a period of practice that they truly understood the product's attributes and what type of products would pass inspection on international markets.

4. Train Dual Purpose S&T and Management Personnel

The participation of high technology products in international market competition in essence is competition in technology, knowledge, and management. In the final analysis, competition is possible only when personnel grasp these technical and management methods. Analyzing the current situation in our scientific research system, special technical experts and research personnel in special disciplines are not rare, but few personnel understand the profession and know how to manage, have a rather strong organizational ability and ideological quality, and have the capacity for "joint attacks on key problems." Sending people to foreign countries for training in certain companies is one route, but the healthy maturity of millions of personnel still requires combined work and study to forge and train in practice within China. During the process of establishing the Shanghai Nisaila Sensor Co. Ltd., the Technical Physics Institute organized a group of advanced and mid-level S&T personnel to participate in practice. Through combined work and study they learned how to organize forces for negotiations with foreign businessmen, how to compile and establish economically based feasibliity research reports, and how to direct enterprise administration and management, and they studied the "business classics" of high technology products during marketing.

The accomplishments of the institute in providing initial training for a group of dual purpose S&T and management personnel during the process of joint investments

with a foreign party have received very good evaluations from the director of Japan Ceramics Kumagai Gumi.

More than 1 year of practice has made comrades in the Technical Physics Institute understand that developing high technology industries cannot be done like the "constant planning, divided topics and expenditures, and calculating things wherever they are done method." There must be a feasibility report for doing market surveys and a group of special personnel who have worked bravely during reform in the S&T system should be organized to participate in implementation. The method can move from the small to the large and from product production to scale economies. This can strengthen joint development of horizontal relationships within China and it can establish scientific research and economic bodies with foreign enterprises in the form of shares. In summary, we should start with reality, change from single line cooperation on scientific research at present, create the conditions, and take the new road of direct cooperation between scientific research and enterprises and between scientific research and foreign enterprises. This type of cooperation should be high level and technologically intensive, which can permit a division of labor from regular enterprises in working in the export-oriented economy.

The leaders and S&T personnel of the Technical Physics Institute were not satisfied with the achievements they had made. They soberly analyzed the current situation and problems that exist and explored ways to form a scale economy for high technology products. Our present enterprises rely on single technologies, produce single products, have a small scale, and have a weak capacity for emergencies. A few years from now, changes in international markets will have a decisive influence on enterprises. Thus, they have strengthened cooperation between the research institute and enterprises, and the enterprise has begun to input a development fund into a research group in the institute for joint development of new products and increased enterprise reserve strength. In addition, improvement of the quality of enterprise personnel in the enterprise has been given a primary status and every opportunity is used for employee education in ideology, technology, working styles, and so on.

To promote reform in the research institute and develop scale economies for high technology products, they are now actively strengthening a broad range of relationships in China and foreign countries and striving to use the sensor company as a foundation for further development of alarms, automatic switches, and other product lines as well as the above product applications services. They have organized forces for research, development, and production for all types of sensors and alarm systems, and they can contract as a group company for design and installation of all types of alarms for large and medium-sized enterprises.

Construction of Gene Bank for Hepatitis B Virus ayw Subtype

40091036a Wuhan WUHAN DAXUE XUEBAO [JOURNAL OF WUHAN UNIVERSITY—NATURAL SCIENCE EDITION] in Chinese No 2, Jun 89 pp 112-116

[English abstract of article by Qi Yipeng [7871 5030 7720], Huang Yongxiu [7806 3057 4423] et al., of the Department of Virology, Wuhan University]

[Text] By recombining the Hepatitis B virus (HBV) ayw subtype DNA with plasmid pBR322 on the EcoRI site and transforming it into E. coli HB101, 466 transformant colonies have been observed on the antibiotic-LB plates. Screening by agarose gel, dot blot and Southern blot shows that the HBV DNA has already been inserted into the vector for positive recombinants. The authors demonstrate that the HBV DNA inserted into the plasmid is able to replicate and express efficiently three HBV antigens in E. coli cells.

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Studies Repeating Given Chromosomal Segment in Rice

40091036b Wuhan WUHAN DAXUE XUEBAO [JOURNAL OF WUHAN UNIVERSITY—NATURAL SCIENCE EDITION] in Chinese No 2, Jun 89 pp 117-120

[English abstract of article by Zhang Tingbi [1728 1694 3880] of the Department of Biology, Wuhan University]

[Text] Chromosomal fusion and fission are sometimes termed "Robertsonian changes." These studies discovered that a duplication of a given chromosomal segment could appear regularly in a few diploid plants derived from a given trisomic. The observation of chromosomes at the pachytene stage showed that those with a repetitive segment were longer than those without a repetitive segment in a common diploid and had more chromomeres. Morphological observation also showed that a diploid with a repetitive segment of chromosome-5 had fine hairs on the surface of the leaf analogy to triplo-5, a diploid with a repetitive segment of chromosome-8 had a rolled leaf analogy to triplo-8, a diploid with a repetitive segment of chromosome-9 had a big grain analogy to triplo-9, and in the diploid with a repetitive segment of chromosome-12, a great increase in spikelets per panicle analogy appeared in triplo-12. This phenomenon shows that constructing gene groups of yield traits can be realized by duplicating a given chromosomal segment or gene locus.

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Isolation of Total mRNA from Immature Beijing Wild Soybean Seeds, Molecular Cloning of Its Complementary DNA

40091036c Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 16 No 3, Jun 89 pp 167-173

[English abstract of article by Bi Yuping [3968 3768 1627], Mi Jingjiu [4717 2529 0046] and Guo Jingcheng [6753 7234 2052] of the College of Biological Science, Beijing Agricultural University]

[Text] Total RNA of immature Beijing wild soybean seeds was isolated by the LiCl precipitation method. The

total mRMA was purified by oligo(dT)-cellulose affinity chromatography. The mRNA thus prepared demonstrated sufficient translation activity whan assayed in a rabbit reticulocyte cell-free system *in vitro*. Using the total mRNA as the template and oligo$(dT)_{12-18}$ as the primer, the first and second strands of cDNA were synthesized respectively by AMV reverse transcriptase and RNase H-DNA polymerase I. The length of the double stranded cDNA synthesized was about 200-5000 bp. The ds-cDNA with perfect blunt ends was inserted into the *SmaI* site of pUC19 by blunt end ligation. The resultant recombinant molecules were used to transform *E. coli* strain JM107, and more than 800 white clones were obtained. Rapid electrophoresis and *Eco*RI-*Hind*III digestion analysis showed that most of the recombinant plasmids from the white clones contained insertions of various lengths, and three out of four tested were about 1700, 2600 and 1400 bp in length, respectively.

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Expression of Ti-Plasmid Genes in Monocots Hemerocallis citrina Lycoris radiata

40091036d Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 16 No 3, Jun 89 pp 174-177

[English abstract of article by Yu Jianping [5713 0494 1627], Jiang Xingcun [5592 5281 6722] and Shao Qiquan [6730 0796 0356] of the Institute of Genetics, Chinese Academy of Sciences, Beijing]

[Text] The *Agrobacterium tumefaciens*-mediated transformation of the monocots *Hemerocallis citrina* and *Lycoris radiata* is reported here. Swellings formed on young floral stems of *H. citrina* and *L. radiata* within 1 month following the onset of infection. The expression of *nos gene* was confirmed by nopaline detection. The host range of *A. tumefaciens* in monocotyledoneae and host screening methods are discussed.

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Study of Bacillus pumilus as Recipient Strain for Genetic Engineering of Bacillus

40091036e Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 16 No 3, Jun 89 pp 206-212

[English abstract of article by Chen Qimin [7115 0796 3046], Geng Yunqi [5105 6663 3825] et al., of the Laboratory for Biotechnology, Department of Biology, Nankai University, Tianjin; Wang Gefu [3769 7245 0126] of Heilongjiang Provincial Institute of Biotechnology]

[Text] *Bacillus pumilus* 289 can be transformed easily by plasmid pUB110 through protoplast transformation with the frequency of 10^{-5}-10^{-3}, similarly to *B. subtilis* AS 1.1176, a derivative strain of *B. subtilis* 168. The regeneration frequency of its protoplast is only slightly lower than that of *B. subtilis* AS1.1176 (0.3-12.0 percent compared to 1.53-24.16 percent).

Plasmid pUB110 can be maintained stably in both bacterial strains. The frequency of loss of the plasmid in both strains is lower than 3 percent after 45 generations in the LB medium. On the other hand, however, the hybrid plasmid (pUB110 with 3.9 kb foreign DNA fragments) can be maintained much more stably in *B. pumilus* 289 than in *B. subtilis* AS1.1176. The frequency of plasmid loss is lower than 5 percent in *B. pumilus* 289 and 24 percent in *B. subtilis* AS1.1176 after 25 generations grown in the SH medium. The expression level of foreign genes in *B. pumilus* 289 is also much higher than that in *B. subtilis* AS1.1176. Therefore, *B. pumilus* 289 is valuable for exploitation as a recipient strain for the genetic engineering of *Bacillus* in the future.

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Synthesis, Cloning of $V_{\gamma 3}$ cDNA of Monoclonal Antibody

40091036f Beijing YICHUAN XUEBAO [ACTA GENETICA SINICA] in Chinese Vol 16 No 3, Jun 89 pp 213-218

[English abstract of article by Shang Furong [1424 5346 5554], Huang Hualiang [7806 5478 2856] et al., of the Institute of Genetics, Chinese Academy of Sciences, Beijing; Chen Hong [7115 5725], et al., of Heilongjiang Provincial Institute of Applied Microbiology, Harbin]

[Text] Using the guanidinium isothiocyanate method, total RNA was isolated from hybridoma cells secreting a

monoclonal antibody against *Brucella melitenses.* Poly $(A)^+$ RNA was obtained by oligo (dT)-cellulose affinity chromatography. A reverse transcriptase reaction was performed with a 3'A-T-A-G-G-T-G-A-C-C 5' primer that is complementary to the No 122-125 amino acid residue codons in the 5' terminus of a constant region. The size of the synthesized ds-cDNA is about 300 bp, and is consistent with the length of heavy chain variable region genes. The ds-cDNA was inserted into plasmid pUC19 with the dC:dG tailing method, and the inserted plasmid was used to transform *E. coli* HB101. It has been proven through clone hybridization *in situ*, the size of the insert, and Southern blot that the insert was a heavy chain variable region gene.

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Cloning, Expression of Tryptophan Synthetase Gene (TRP5) in Yeast

40091036g Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 3, Jun 89 pp 174-179

[English abstract of article by Yun Dingfang [1926 1353 2455], Liu Yufang [0491 3768 2455] and Cai Jinke [5591 6855 4430] of the Institute of Microbiology, Chinese Academy of Sciences, Beijing]

[Text] TRP5, one of the five genes required for tryptophan synthetase is *S. cerevisiae*, has been isolated on recombinant plasmids. A genomic DNA bank, containing the entire yeast genome, was constructed by complete digestion of yeat 1412-4D DNA with restriction endonuclease *Bam*HI, size fractionation by sucrose gradient (2-4kb), and insertion of the fragments into the yeast shuttle vector pCN60. Nine recombinant plasmids capable of complementing trp5 mutations were isolated through transformation of yeast cell C9 (α, trp5, ade1, ade6). The recombinant plasmids, containing 3.2 kb DNA fragments locating the TRP5 gene, were named pCN60 $(TRP5)_{1-9}$. The tryptophan synthetase activity of the transformants was three-fold higher than that of the original strain 1412-4D.

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Chromosomal Transfer of Agrobacterium Tumefaciens by Conjugating, Genetics Study of Biotype Characteristics

40091036h Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 3, Jun 89 pp 187-194

[English abstract of article by Su Hongsheng [5685 7703 5116], Xiang Wangnian [4161 2598 1628] and Dai Xiuyu [2071 4423 3768] of the Institute of Microbiology, Chinese Academy of Sciences, Beijing; Lu Deru [7120 1779 1172] of the Laboratory of Molecular Genetics, Second Military Medical College, Shanghai]

[Text] By using transposon Tn5-Mob and plasmid R68.45, the authors transferred the chromosome of *Agrobacterium tumefaciens* biotypes II and III to the biotype I strain which has three auxotrophic markers. Seven groups of trans-conjugats were obtained. After analyzing the main classical characteristics of the biotypes (3-ketolactose production; limus milk; acid production from erythirtol, ethanol and melezitose; alkali from mucic acid; growth on selective media New and Keer), the authors found that these characteristics had transferred to the recipients.

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Discovery, Study of Invasive Strain of Escherichia Coli O_{121}

40091036i Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 3, Jun 89 pp 216-221

[English abstract of article by Yang Zhengshi [2799 2973 2514] and Huang Nianjun [7806 1819 0689] of the National Institute for the Control of Pharmaceutical and Biological Products, Beijing; Zhang Chaofan [1728 6389 0416],et al., of the Sanitary and Anti-epidemic Station of Yueyang, Yueyang]

[Text] A strain of enteroinvasive *Escherichia coli* was isolated from the stool containing blood and mucus of a child suffering from acute diarrhea. The strain shows the following characteristics: rapid fermentation of glucose (with gas), no fermentation of lactose, β-galactosidase reaction positive, growth in acetate media, lysine decarboxylase negative, non-motility causing keratoconjunctivitis in guinea pigs and invading of epithelial cells, with a plasmid of 140 Md. The serotype is O_{121}:H-, which is a a new serotype of enteroinvasive *Escherichia coli.*

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Restriction Map of E. Coli Shuttle Plasmid ($p^{\#}$ GTE5) with Secretive Function

40091036j Beijing WEISHENGWU XUEBAO [ACTA MICROBIOLOGICA SINICA] in Chinese Vol 29 No 3, Jun 89 pp 228-231

[English abstract of article by Chen Yuexian [7115 2588 0103], Qiu Hongchen [5941 1347 3819] et al., of the Department of Biology, Beijing University]

[Text] The shuttle plasmid ($p^{\#}$ GTE5) DNA with a secretive function was extracted by the alkali lysozyme method from the *E. coli* RRI strain. Its molecular weight was 4.5 Md and DNA size was 6.9 Kb. Restriction fragments of the plasmid were obtained by single and double enzyme complete digestion using five different restriction endonucleases. The restriction map of the shuttle plasmid ($p^{\#}$ GTE5) was established for the enzymes *Eco*RI, *Bgl*II, *pst*I, *Pvu*II and *Taq*I.

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Acid Rain Situation Seen Worsening

Heaviest Damage Still in Southwest

40081045 Beijing KEJI RIBAO [SCIENCE AND TECHNOLOGY DAILY] in Chinese 26 Jun 89 p 3

[Article by Li Shengfang [2621 4141 5364]]

[Text] Monitoring of China's acid rain began at the end of the seventies. In 1982, the State Bureau of Environmental Protection organized a nationwide acid rain survey and southwestern region acid rain research. In 1985, the first batch of results was obtained. The Chinese Academy of Sciences in 1983, organized a joint research effort by the Institute of Environmental Chemistry, the Atmospheric Institute, the Institute of Forestry and Pedology, and other organizations on acid rain in the Chongqing and Guiyang areas. In May 1987, the investigative group on "damage to agriculture by acid rain and countermeasures," organized by the China Association of Science and Technology and the China Society of Forestry, and with the participation of specialists assigned by 19 scholarly societies nationwide, carried out an integrated investigation into meteorological, geographical, biological and many other aspects of areas in southern China with serious acid rain.

A large amount of monitoring data indicates that precipitation with a pH of less than 5.6 is primarily distributed in southern China. In some places in Sichuan, Guizhou, and Guangxi, the average annual pH value of precipitation is lower than 5.0, having become at present the areas most seriously contaminated with acid rain in China. In general, the pH of precipitation in all southern cities is lower than that of cities in the North. Acid rain exhibits a multi-centered distribution with cities at the cores. The acidity of urban area precipitation is strong and that of outlying areas is weak. As regards seasonal distribution, the acidity of winter precipitation is stronger while that of the summer is weaker, however, yearly changes are not obvious. This kind of spatial and seasonal rain distribution is similar to the distribution of atmospheric sulfur dioxide pollution.

Aircraft were used from 1983 to 1985 in the southwestern region to carry out upper air observations. At an altitude of 2,000 to 3,000 meters, the phenomenon of rainwater acidification had not yet been discovered. China's present acid rain is basically a surface problem located close to cities. The phenomenon of sulfur dioxide being transmitted long distances, leaving the ground and forming acid rain has yet to be discovered.

Acid rain damage in the southwestern region is related to the geographical environment. This region's climate is moist and warm, the atmospheric temperature inversion layer is thick, stability is good, the frequency of calm winds is high and sulfur dioxide is not easily dispersed, remaining for longer periods in the air above cities and easily creating acid rain. Moreover, the soil of these areas is for the most part acidic. After acid rain falls, it is not so easily neutralized as in the alkaline soil of the North. This causes soil acidification, affecting soil quality. Chemical testing indicates that 90 percent of the acidic material in acid rain of the southwestern region is sulfuric acid radical. Clearly it is created by sulfur dioxide, produced by burning coal. The coal of this region is high in sulfur content; coal of some Guangxi mines has a sulfur content as high as 15 percent. China's present acid rain is of the sulfuric acid type. A great deal of research work indicates that along with China's daily worsening of atmospheric pollution, the discovered scope, strength, and frequency of acid rain occurrence all have an intensifying tendency.

From 1985 to 1986, the Chinese Academy of Environmental Sciences carried out comprehensive research into the relationship between acid rain at Chongqing's Nanshan and the death of pine forests. Four consecutive months of observations were carried out on rain water in the Nanshan pine forest area. The results indicated that the frequency of acid rain in Nanshan was 100 percent, the average pH value of rainwater was between 4.2 and 4.4 with the lowest being 3.6, and the rainwater was of the sulfuric acid type. Over half of the 27,000 mu of pines at Chongqing's Nanshan have died.

The harm done to plants by acid rain has two aspects, direct and indirect. Many simulated acid rain experiments indicate that rainwater with a pH of less than three produces direct damage to plants, causing spots to appear on leaves. The indirect effect of acid rain is caused through the acidification of soil. Masson pines close to death have the symptoms of needles showing spots, withered tips and whole needles that are withered and yellow. The internal tissue of the leaf is destroyed and they drop off early. The introduction of acid rain over a long period results in soil acidification, causing nutritional imbalance in the pines, chronic lead poisoning, tissue necrosis, and poor growth.

Acidification has a clear effect on the electrical charge and ion absorbtion of soil. As the pH value drops, the positive charge of red earth increases and the negative charge is reduced, thus causing the net negative charge to be reduced even further. After red earth acidification, not only is the absorbtion of the nutritive ions of potassium, ammonium, calcium and magnesium markedly reduced, moreover, the stability level of absorbtion is also greatly reduced. Soil acidification is a complex, long-term process, there is potential for further effects.

The soil of the forests in China's southwestern region is mostly yellow earth, relatively sensitive to acid rain. In those areas in which the average pH value of the annual precipitation is less than 4.5, the total number of soil microorganisms is 72 percent that of areas with a pH value greater than 4.5. In particular, the actinomyces and bacteria are clearly reduced. Among the bacteria, those chromogenic bacteria able to breakdown organic matter, and spore-producing bacilli, in particular, show obvious reductions. This reduces the ammoniation, nitrification, and nitrogen fixation of soil microorganisms. In the vegetable fields in the vicinity of Jiulongpo adjacent to

the Chongqing power plant, eggplant sprouts have died, the leaves of melon plants have blotch wither and the variety and yield of vegetables is decreasing year by year. In Sichuan's Fengjie County, 90,000 mu of huashan pine has virtually died. Even Emeishan which is termed a "natural botanical garden" constantly has large areas of fir trees dying. According to estimates, as a result of acid rain, maintenance and repair costs of the Jialingjiang bridge will increase by 170,000 yuan annually. Four times a year rust removal and painting must be done on the bridge's steel beams. Each year there is 110,000 yuan in losses in the Chongqing urban area to streetlights and 120,000 yuan in losses to public buses. Only 3 years after completion of construction of the Chongqing municipal television tower, corrosion was discovered.

Preventive Measures:

I. Reduce Amounts of Released Pollutants

The fundamental route to the control of acidic precipitation is control of the released amounts of atmospheric pollutants which create acid rain. The primary methods include the use of low-sulfur fuels, prevention of pollutant formation during the combustion process, the separating out of pollutants from flue gases, and the improvement of energy efficiency.

The burning of low-sulfur coal and petroleum is the simplest means of reducing quantities of sulfur. Coal contains two kinds of sulfur: inorganic sulfur and organic sulfur. Inorganic sulfur can be eliminated through smashing, grinding and washing. On average, one-half of inorganic sulfur can be removed and at best, 90 percent can be eliminated. Chemical sulfur-removing methods are more effective and can remove both inorganic and organic sulfur, but the cost is too high.

In the combustion process, adopt control measures to reduce the amounts of sulfur oxides and nitrogen oxides released. Adoption of all types of liquified combustion technology is one kind of effective method to reduce the amounts of sulfur and nitrogen oxides emitted from power plants. The boiling state combustion exhibited by fine coal in fluidized beds along with the introduction of quantities of lime and dolomite into the bed can effectively control the amount of sulfur oxides generated. The temperature of coal in fluidized state combustion is lower than the combustion temperatures of common boilers, therefore, the amount of nitrogen oxides generated is also reduced by a clear margin.

Implementation of flue gas desulfurization and denitrification: the removal of nitrogen oxides is accomplished by installation of a selective catalytic reducing unit in the lower boiler. After the gases pass through this system, they enter the desulfurization system. Another type of units connects the sulfur dioxide and nitrogen oxide removal units, i.e., a synchronous method. It uses the same unit to achieve removal of sulfur dioxide and nitrogen oxide.

In 1986, the State Planning Commission and the State Bureau of Environmental Protection, allocated 10 million yuan and to carry out key experiments in boiler gas desulfurization at the Tianyuan chemical plant's thermal power plant in Chongqing. This unit is an alkali-type aluminum sulfate method sulfur recovery unit. It is presently China's first set of industrial-type experimental equipment in environmental protection, and is intended for alleviating acid rain damage and providing data.

II. Lime Treatment

Although the lime method can reduce a certain amount of acidity, it cannot truly solve the problem. It can only be used as an interim measure. The price of using lime treatment is very expensive, moreover, it must be repeated many times. In regard to soil and bodies of water which have already been affected by toxic metallic elements, the use of lime could even exacerbate the effects of these metals on animals and plants.

Newly Polluted Regions in East

40081042b Beijing RENMIN RIBAO [OVERSEAS EDITION] in Chinese 3 May 89 p 4

[Article by Chen Xin [7115 2450], Xinhua She reporter: "Acid Rain Polluted Areas Spreading in China—Ecological Imbalances in Polluted Areas and New Environmental Problems in Eastern Coastal Region Linked to Acid Rain"]

[Text] Beijing, 2 May—This reporter has learned from the National Environmental Protection Agency that more and more areas in China are affected by acid rain. In the last 3 years, acid rain pollution has been steadily spreading from the southwest to the north and to the east.

The latest survey showed that the acid rain-polluted regions in China have grown from two to four.

One of the newly polluted regions is around Xiamen and Fuzhou. The second region is centered at Qingdao.

The previously identified two acid rain-polluted areas are: the region around Chongqing that includes Guiyang, Liuzhou, Zigong, and Nanning, and the region around Nanchang extending as far as Huangshi, Changsha, and Pingxiang.

Today, in the southwest, the Nanchang pollution region as well as the Xiamen pollution region, the probability for acid rain deposit is around 90 percent, causing ecological damage such as soil acidification, decline in agricultural output, forest destruction, and worsening blights.

Scientists had established that the acid rain is caused by high levels of sulfur dioxide in the atmosphere. The spread of pollution areas is an inescapable consequence of industry development and huge increases in coal consumption.

Statistics show that 75 percent of our energy depends on coal. In 1988, a total of 956 million tons of coal was burned in China; as a result, more than 15 million tons of sulfur were emitted into the atmosphere.

Clean-air experts have concluded that the long-term solution to acid rain is to seek alternate energy sources, such as a safe and pollution-free nuclear power.

Great Wall Station Provides New Gateway for Meteorological Studies

40081042a Beijing BEIJING KEJI BAO [BEIJING SCIENCE AND TECHNOLOGY NEWS] in Chinese 3 May 89 p 3

[Article by Jia Pengqun [6382 2590 5028]: "Antarctica Meteorological Studies—A New Area of Meteorological Study for China"]

[Excerpts] [Passage omitted] In the last 4 years, many scientific research projects have been conducted at the Great Wall Station; the Antarctica meteorological study is one of the more important programs among them. Today, the Great Wall Station has developed into a better-equipped, year-round weather observation post. Among the many services this outpost can provide include surface meteorological observation, weather forecast and analysis, meteorological communications and satellite weather photograph receiving as well as special meteorological studies. The data collected at the Great Wall Station, identified by station number 89 058 and referenced with real time, can be accessed by weather services and researchers all over the world through the global weather surveillance network.

Located at latitude 63°13' south and longitude 58°58', the Great Wall Station is some 17,500 km from Beijing. The long, narrow Antarctic Peninsula juts into the Antarctic Ocean from the western continent and off its southern tip, stands Prince George Island, home of the Great Wall Station. This cleverly-chosen location, positioned outside the radius of the Antarctic continental cold front and protected by the relatively warm ocean current, is one of the few regions that enjoy the mildest climate in the Antarctic. The meteorological records of the past four years showed the annual average temperature at the Great Wall Station is -2.6°C. Seasonal temperature variations are relatively small; the biggest annual temperature difference is 9.1°C. The climate is typically subpolar oceanic.

The locale of the Great Wall Station is like a gateway to the Antarctic mainland, although too far to be exposed to the severe cold from the Antarctic hinterland, it still offers the best vantage point for conducting many specific meteorological studies. For example, there the water on the bedrock surface is constantly undergoing complex phase transformations; seasonal fluctuations of seaice in coastal areas and of accumulated ice in inland have been observed. The physical process of phase changes on the bedrock surface involves seawater-seaice- land- ice sheet and often affects the weather of the area above. The observation and study of these processes and phase transformations will help us understand the characteristics and changes of the Antarctic cold source and its effect on global weather as a whole. Therefore, between 1987 and 1988, Chinese meteorological researchers at the Great Wall Station observed micrometeorological changes on a 32-meter communication tower. Pertinent data regarding temperature, humidity and physical differences of the stratified wind and heat radiations in five different elevations ranging from 0.5 to 32 meters were collected. Based on these data, an analysis of thermal equilibrium on the earth's surface in the Great Wall Station area was initiated. The result of the preliminary study indicated that although this area is covered by snow and ice in eight months each year, however, owing to the large amount of radiation the ocean and naked land receive from the sun in summer, on an annual average, the bedrock surface underneath this area is still a heat source to the atmosphere above, albeit a weak one at that. The energy that warms the atmosphere mainly comes from the heat stored in the bedrock surface. Moreover, geographically the Great Wall Station area is also the area in the Antarctica closest to a civilized continent; the southern tip of South America is approximately 1,000 km distant. It is very likely that air pollution enters the Antarctica here. Consequently, the services an air quality surveillance post at this unique location can provide should greatly facilitate the watch on the air pollution conditions in the Antarctica, and thereupon, the forecast on the air quality over the entire globe. The Antarctic ozone hole, which has attracted wide attentions recently, is centered to the southwest of the Antarctic Peninsula. Steps have been taken by agencies in charge to include environmental surveillance as one of our important scientific research projects in the Antarctica. [passage omitted]

In the beginning of this year, the Antarctic Zhong Shan [0022 1472] Station was completed. The dedication of this new station will undoubtedly help further advance the Antarctic research of our nation.

Mode Locking Characteristics of Nd:YAG Lasers With $LiF:F_2^-$ Color Center Crystals

40090065a Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16 No 6, 20 Jun 89 pp 324-326

[Article by Qiu Peixia [5941 0160 7209], Zhou Fuxin [0719 4395 2450] and Yu Hong [0060 5725] of Shanghai Institute of Optics and Fine Mechanics, and Li Shenghua [2621 0524 5478] of Center of Physical-Chemical Analysis, Jiaotong University, Shanghai]

[Abstract] Since the optochemical properties of $LiF:F_2^-$ color center crystals are stable at room temperature and have a high degradation threshold, homogeneous optical quality, high thermal conductivity and convenience in use, $LiF:F_2^-$ color center crystals used for laser excitation media and Q-modulated components were studied extensively. The paper studies the mode-locking properties of an Nd:YAG laser, using $LiF:F_2^-$ color center crystals as the saturable absorber. The pulse-splitting phenomenon (appearing in a Q-modulated process) of high-gain $LiF:F_2^-$ color center crystals with an active acousticooptical modulator was utilized to analyse the mode-locking properties in generating a stable mode-locking pulse train with a 1.5 ns single pulse duration.

Three figures show the experimental arrangement, laser waveform while the acousticooptical modulator is not operating, output-mode locking sequence while the modulator is operating, and stability of mode locking energy while the $LiF:F_2^-$ color center crystal is used as saturable absorber.

The paper was received for publication on 30 December 1987.

Generation of Continuously Tunable Ultraviolent (UV) Radiation From 200 to 218 Nanometers Using a BBO Crystal

40090065b Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16, No 6, 20 Jun 89 pp 327-329

[Article by You Chenhua [1429 2525 5478], Lu Zukang [7120 4371 1660] and Fan Qikang [5400 4359 1660] of Optical Engineering Department, Zhejiang University, Hangzhou, and You Guiming [1429 2710 6900] of Fujian Research Institute of Materials Science, Chinese Academy of Sciences]

[Abstract] With a BBO crystal, a 492-550 nm laser has its frequency doubled, and then the secondary harmonics are mixed with the 1064 nm frequency outputted from the Nd:YAG laser in obtaining tunable 200-218 nm ultraviolet radiation. Thus, with the BBO crystal, the wavelength of tunable ultraviolet radiation can be extended to 200 nm at room temperature.

Six figures show a correlation between the mixing-output wavelength and the matching angle, the effective non-linear polarization rate generated by mixing 1064 nm and tunable ultraviolet radiation, the acceptance angle of the BBO crystal in the 200-220 nm waveband, a schematic diagram of the experimental arrangement, the distribution curve of energy versus wavelength of the dye laser and its double-frequency light output, and a photograph of the glowing spots of the dye laser at 510 nm.

The experiments were accomplished at the physics department, Fudan University. The authors are grateful to Professor Li Fuming [2621 1381 6900]; instructors Xia Jingfang [1115 2417 5364] and Wang Guoyi [3769 0948 4135]; and doctoral candidate Xu Lei [1776 7191] for their assistance. The paper was received for publication on 30 August 1988.

Output Mode Properties of Injection-Locked Short Pulse Dye Lasers

40090065c Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16 No 6, 20 Jun 89 pp 356-358, 353

[Article by Zhang Tiejun [1728 6993 6511] of Changchun Institute of Optics and Fine Mechanics, Chinese Academy of Sciences]

[Abstract] Utilizing Fourier transforms, the author calculates in detail and discusses the properties of the power gain coefficient of injection-locked short-pulse dye lasers, and derives an approximate equation for the frequency spectrum of the output light field. Thus, the output mode and the factors influencing it are analyzed.

Using short pulses without longitudinal mode-locking, the fundamental cause of achieving injection locking is shown to be the effective broadening of the injection light bandwidth. Also discussed are problems of a possible multimode output.

As shown from the analysis in this paper, frequency mismatching also affects the injection-locked output mode. This effect is more pronounced when the injection photon density is higher. For the output to be in the single longitudinal mode, it is necessary to raise the injection photon density, in addition to matching with the longitudinal mode.

One table lists data of steady-state parameters used in the calculation. Six figures show a correlation between the power gain coefficient on the one hand, and injection wavelength, injection photon density, and frequency-mismatch factor, on the other; a correlation between the Lorentz distribution factor and output light frequency, and a diagram for the calculating power gain coefficient.

The author is grateful to Wang Naihong [3769 0035 1738] and Xu Fengming [6079 7685 2494] for their assistance. The paper was received for publication on 26 October 1987.

Effect of Condensors on the Homogeneity of Optical Pumping

40090065d Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16 No 6, 20 Jun 89 pp 359-361

[Article by Ding Liming [0002 7787 2494] of Shanghai Institute of Optics and Fine Mechanics, Chinese Academy of Sciences; Yang Fumin [2799 4395 3046] of Shanghai Observatory; as well as S. R. Bowman, J. Fogleman, and C. O. Alley of University of Maryland]

[Abstract] The sandwich-type amplifier demonstrates a new development direction of solid-state laser. In its development, it was required to have pumping homogeneity for flickering lamps in order to enhance the wavefront surface quality of the laser beam and to eliminate laser beam birefrigence. In addition, to enable the sandwich type amplifier to withstand the high-power energy input and high repetition frequency, pumping homogeneity is also required besides the reduction in stress generated in the sandwich type amplifier. An important step in obtaining pumping homogeneity is to find an appropriate condenser.

To solve the problem of optical pumping homogeneity in the sandwich type amplifier, nearly ten types of condensers were studied; eventually, over 98 percent optical pumping homogeneity was achieved.

One table lists data on root mean square error of the distributed fluctuations in optical pumping for various cavity types. Six figures show the sandwich type Nd:YAG reflecting mirror type laser amplifier, measurement arrangement and curves for the optical pumping energy distribution, simulation of multiple lamps with multiangle cavity, its energy distribution at different angles, and a multiangle cavity for $\theta = 0$.

The paper was received for publication on 9 December 1987.

Folded Resonator of Transverse-Flow High Power CO_2 Lasers

40090065e Shanghai ZHONGGUO JIGUANG [CHINESE JOURNAL OF LASERS] in Chinese Vol 16 No 6, 20 Jun 89 pp 383-384

[Article by Zheng Qiguang [6774 0796 0342], Yuan Bin [5913 2430] and Li Zaiguang [2621 0375 0342] of Laser Institute, Huazhong University of Science and Engineering]

[Abstract] Enhancements of the light beam quality from high power CO_2 lasers and the far-field focusing property of the output light beam are an urgent problem in extending the applicability of high-power transverse-flow CO_2 lasers. The authors adopted the folded resonator structure in the multimode pin-shaped, panel type discharge, transverse-flow CO_2 laser with a 2 kW output; thus, the resonator length was increased, the high order mode diffraction loss was raised, high order mode oscillation was suppressed, and the magnitude of the fundamental mode was increased. An output of 1,020 watt TEM_{oo} (quasifundamental mode) was obtained with the electric energy to light conversion efficiency greater than 8.6 percent; the low order mode (TEM_{1o} output is 1,020 watts with an electric energy to light conversion efficiency above 9 percent.

The article describes the output properties of the folded resonator of a transverse-flow CO_2 laser, the effect of the reflectivity of multireflective mirrors on output power, and focusing and cutting-welding experiments with a folded resonator type output light beam.

Six figures show the folded resonator structure, its output light spots, the correlation curves between the maximum output power and reflective mirror losses, effect on laser output power by variation in folded mirror reflectivity, light beam focusing, and laser experiments in cutting and welding.

The article was received for publication on 23 December 1987.

Quantum Theory of Surface Polaritons in Semi-Infinite Ionic Crystal

40090064a Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 8 No 2, Apr 89 pp 89-96

[English abstract of article by Xu Zhanglong [6079 2222 7893], Gu Shiwei [7357 0013 3161] et al., of the Department of Applied Physics, Shanghai Jiaotong University]

[Text] The interaction system of the long-wave optical modes (P-Polarization) in a semi-infinite diatomic ionic crystal with the electromagnetic field propagating parallel to the surface is studied using quantum field theory methods. The dispersion relations of surface phonon-polaritons and the $k_{//}$-dependence of the electric field strength are derived and are consistent with the macroscopic theoretical results. The dispersion relation of the polariton leaking modes coming from the bulk TO mode with the surface effect is also presented. The spatial dependence of the polariton field strength and energy are studied, and it is found that these properties are modulated by the longitudinal characteristics of the electromagnetic excitations in the medium, thereby restraining the divergent nature (the diffraction effect) of the light propagating along the waveguide.

This project has been supported by the Fund of the National Natural Sciences of China.

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Dynamic Study of Phonon Spectra of $YBa_2Cu_3O_{7-}$ Superconductor

40090064b Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 8 No 2, Apr 89 pp 97-101

[English abstract of article by Zhang Guizhong [1728 6311 1813], Li Haoliang [2621 3185 0081] et al., of the Department of Physics, Nankai University, Tianjin; Yan Jie [7051 2638], et al., of the Department of Chemistry, Nankai University, Tianjin; Liu Baorui [0491 1405 3843], et al., of the Department of Electronic Sciences, Nankai University, Tianjin]

[Text] Mid-IR transmittance spectra of $YBa_2Cu_3O_{7-\delta}$ superconductors are measured in the temperature range of from room temperature to 10 K. The significant difference in spectra between the superconducting phase $YBa_2Cu_3O_{7-\delta}$ and other phases is found, and is thought to be closely related to the superconducting behavior. The effect of the strong electron-phonon coupling on the high-T_c superconductivity process is discussed in terms of the group theory for phonon selection rules.

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Investigation of Optical Properties of Strained-Layer Coupled Quantum Wells in InGaAs/GaAs

40090064c Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 8 No 2, Apr 89 pp 103-110

[English abstract of article by Xu Qiang [1776 1730], Xu Zhongying [1776 0112 5391] et al., of the Institute of Semiconductors, Chinese Academy of Sciences, Beijing]

[Text] The optical properties of the strained-layer coupled quantum wells in InGaAs/GaAs have been investigated by the photoluminescence and photocurrent spectrum techniques. The excitonic transitions of both heavy and light holes are observed in the spectra and are assigned by their polarization features. The experimental results show that the energies of heavy hole excitons corresponding to transitions of symmetry to symmetry states shift to lower energies as the barrier becomes thinner in the coupled wells. The excitonic transition energies calculated using a model of two coupled wells, which takes into account both strain and quantization, are in good agreement with the measured values. This work also suggests that light holes are confined in the GaAs layer for the In composition of the sample.

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Far-Infrared Reflection Spectra of $Ti_xY_{1-x}Ba_2Cu_3O_{7-y}$ Superconductors

40090064d Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 8 No 2, Apr 89 pp 121-124

[English abstract of article by Yu Zhiyi [0205 1807 3015], Ye Hongjuan [0673 4767 1227] et al., of the Laboratory for Infrared Physics, Shanghai Institute of Technical Physics, Chinese Academy of Sciences; Li Guangyuan [2621 0342 6678] of the Physics Department, East China University of Chemical Technology, Shanghai]

[Text] The far-infrared reflection spectra of the high T_c superconductors $Ti_xY_{1-x}Ba_2Cu_3O_{7-y}$ (x = 0.2, 0.4) are reported. At least seven phonon structures have been observed, at about 136, 154 (or 151), 193, 230, 280, 293 and 337 cm^{-1}. The energy gap is estimated as 2Δ is approximately equal to 198 cm^{-1}, corresponding to a ratio of $2\Delta/k_BT_c$ is approximately equal to 3.4. The physical origin of the phonons is discussed.

The project has been supported by the Fund of the Chinese National Natural Sciences.

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Radiative Transition, Energy Transfer of Bound Exciton in GaP:N Crystals

40090064e Shanghai HONGWAI YANJIU [CHINESE JOURNAL OF INFRARED RESEARCH] in Chinese Vol 8 No 2, Apr 89 pp 125-130

[English abstract of article by Lin Xiuhua [2651 4423 5478], Jiang Bingxi [3068 3521 3556] et al., of the Department of Physics, Xiamen University, Xiamen, Fujian; Wang Naiguang [3769 0035 0342], et al., of Anhui Institute of Optics and Fine Mechanics, Chinese Academy of Sciences, Hefei]

[Text] This paper reports investigations of time-resolved luminescence (TRL) in the temperature range of from 9.3 to approximately 72.2 K of GaP:N crystals excited by YAG:Nd laser operating at 355 nm (the third harmonic genration). The energy and duration of the pulsed YAG laser are typically 3.4 mJ and 10 ns, respectively. The fluorescence decay ofthe NN_1, NN_2 lines in the photoluminescence spectra is measured using a system consisting of a transition digitizer and a multichannel analyzer.

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Success Claimed With 1.5-MeV Linear Accelerator

40080204a Beijing GUANGMING RIBAO in Chinese 20 May 89 p 2

[Article: "China Develops 1.5-MeV Induction Linear Accelerator"]

[Text] A 1.5-MeV linear accelerator of the new induction type has been successfully developed by Institute No 1 of the Chinese Institute of Engineering Physics. This is a major new Chinese achievement in high science and technology that follows the Beijing Electron Collider, the China No 1 Circulator, and the Lanzhou Heavy Particle Accelerator. More than 100 specialists, including academic committee members of the Chinese Academy of Sciences Wang Ganchang [3769 3227 2490], Chen Nengkuan [7115 5174 1401], Yu Min [0060 2404], Xie Jialin [6200 1367 7792] and Liu Shenggang [0491 4141 4854], who recently evaluated this product in Mianyang, Sichuan, concluded that the accelerator fills a gap, and that it is on a par technically with foreign devices of the same kind and represents the world state of the art.

The linear inductive accelerator is a new accelerator type that has been developed in the last few years. It combines the advantages of high-power pulse technology and conventional accelerator technology and is capable of producing a high-energy, high-current, high-quality electron beam. To meet the needs of research on free electron lasers, the scientific and technical personnel of Institute No 1 of the China Institute of Engineering Physics undertook the 1.5-MeV induction linear accelerator project in 1983. Relying on domestic capabilities, by self-reliance and arduous struggle they obtained the materials and components for the accelerator and tacked a series of difficult technical problems, including high-voltage insulation, synchronization of multiple main switches, measurement of beam emission power, diode structures and the like, and ultimately succeeded in developing the accelerator. It has already passed more than a thousand discharge tests, which have shown that its operation is safe and reliable and that its characteristics are stable with good reproducibility.

The development of this accelerator makes China the third country in the world, following the United States and the Soviet Union, to have mastered this reactor development technology. It is of importance to China's research on free electron lasers.

Nation's First Proton Accelerator Developed in Beijing

40080204b Beijing KEJI RIBAO in Chinese 31 May 89 p 1

[Article: "Construction of China's First Linear Proton Accelerator Completed in Beijing]

[Text] The Chinese-designed, Chinese-built Beijing Linear Proton Accelerator has been completed and recently passed its evaluation at the Institute of High-Energy Physics, Chinese Academy of Sciences.

With an energy of 35 MeV and a pulse current of 60 mA, the accelerator incorporates many advanced technologies, such as a superhigh-frequency radio technology, high-voltage technology, high-vacuum technology, precision mechanics, high-precision optical and electromagnetic measurement, and computer-automated control technology. It will produce short-lived isotopes for medical use and will be used for neutron treatment of cancer. Many of the important short-lived neutron-poor isotopes used in nuclear medicine, such as carbon-11, fluorine-18, gallium-67, iodine-123 and thallium-201, can be made in the accelerator's isotope production unit; and its fast-neutron generation system, together with a treatment positioning system, a neutron dose measuring system and automatic control system make up China's first neutron cancer treatment unit, which will provide a facility for medical research on the neutron treatment of cancer. In addition, it will provide certain basic-research organizations and advanced institutes and schools throughout the country with neutron beams for nuclear physics and nuclear chemistry research.

Scientists believe that the construction of the Beijing Linear Proton Accelerator marks a new level of achievement in reactor development in China and that it will make a major contribution to China's reactor technology and applications.

Superconductivity Research Claimed Still World-Class

40080204c Beijing GUANGMING RIBAO in Chinese 10 May 89 p 1

[Article: "China's Superconductivity Research Still in World Forefront"]

[Text] Despite the fact that funding and equipment for scientific research are not as abundant in China as in other countries, China continues to post new research results in the field of high-temperature superconductivity, a subject that is attracting great attention throughout the world. A survey of relevant leadership personnel of the State Science and Technology Commission and the State Planning Commission and specially invited experts indicates that China's superconductivity research is still in the world forefront.

Since the emergence of high-temperature superconductivity 2 years ago, the focus of international competition has been on applying superconductivity at the temperature of liquid nitrogen as rapidly as possible and on finding superconductors with even higher critical temperatures. The key problem in this connection is to increase the critical current density of superconductive materials. The critical current density of China's yttrium-series superconductive materials has already reached 6000 A/cm2, close to the highest values obtained worldwide.

The fundamental reason for the great applications potential of superconductors with high critical current densities is the need for high-quality superconductive films. The maximum critical current density of yttrium-series superconductive films developed in China is a million A/cm2; both process reproducibility and film stability are on a part with the world state of the art.

A Chinese-developed radio-frequency superconductive quantum interferometer has a magnetic field measurement sensitivity of up to 2.10-8 gauss, with good operating characteristics. Chinese scientists have used this interferometer to measure miniscule changes in the electric currents in human tissue, which are very difficult to detect.

Recently, China has discovered a bismuth-lead-antimony-strongium-calcium-copper superconductor with zero resistivity at 132 K and 164 K, setting a new world record for the critical temperature of superconductivity.

In addition, China has done extremely significant work in such areas as the superconductive electrical characteristics of superconducting materials, single-phase monocrystal preparation, crystal structure, microstructure, transport characteristics and magnetic flux probes, resulting in a deeper understanding of the nature of superconductivity.

In its efforts to make solid progress in applications of high-temperature conductivity, China is also facing arduous tasks: there is a great deal of work to be done on carrier [?] materials, films, and new materials, as well as basic research. The State Science and Technology Commission has declared that superconductivity research must further concentrate its objectives, organize its forces and continue vigorous efforts on key problems; engage in profound basic research and academic guidance and optimize process flowcharts; and pursue research with promise of near-term applications and give focused support to research on the applications of low-temperature superconductivity. In addition, we must vigorously take the initiative in developing international exchange and cooperation.

Investigation of Ionic Characteristic of Chemical Bond in Compound Semiconductor, Its Effect on Ionic Range Parameters

40090073a Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 38 No 6, Jun 89 pp 923-930

[English abstract of article by Wang Dening [3769 1795 1337], Wang Weiyuan [3769 3262 3293] et al., of Shanghai Institute of Metallurgy, Chinese Academy of Sciences]

[Text] Based on the molecular-orbital theory, the secular equation for molecules consisting of two different atoms can be deduced. Having solved this equation, the quantitative expressions for the characteristic constants N and λ for the linearly combined wave function of the compound and the equation of the bond forming energy or the anti-bond forming energy are obtained. Using the difference between these two energies, the N and λ can be related to the average energy gap E_h arising from the symmetric potential V_{cov}, the energy gap C arising from the anti-symmetric potential V_{ion}, and the total energy gap E_g, and, therefore, the dependence of λ on the fraction of the spectrum ionicity f_i and the ratio C/E_h are deduced. From the dependence of λ on f_i, the expression connecting f_i and the deviation coefficient γ for the electronic stopping power of the compound may be obtained.

According to the above equations and taking into consideration the structural characteristics of zincblende and wartzite structures, the cause of the difference in the deviation coefficient γ and the piezoelectric constant e_{pol} between the two structures can be well explained. The same turning point can be found in all three curves expressing the dependence of C/E_h, γ and e_{pol} on f_i, respectively, and, therefore, it can be seen that the bond and structural properties of crystals will be the most significant cause of changes in chemical and physical properties of semiconductor compounds.

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Study of Crystallization Kinetics of Superconducting Metallic Glass $Zr_{78}Co_{22}$

40090073b Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 38 No 6, Jun 89 pp 931-937

[English abstract of article by Zhou Xianyi [0719 0341 1942], et al., of the Department of Physics, University of Science and Technology of China, Hefei; Liu Zhiguo [0491 3112 0948], et al., of the Laboratory of Solid State Microstructures and Materials Analysis Center, Nanjing University]

[Text] The structure, structural relaxation and crystallization of the metallic glass $Zr_{78}Co_{22}$ are investigated by small angle X-ray diffraction, wide angle X-ray diffraction and field ion microscopy, while measurements are taken of the superconducting critical temperature and the microhardness. The results indicate that amorphous

phase separation exists obviously in the as-quenched state of the metallic glass $Zr_{78}Co_{22}$. The compositions of two segregated amorphous phases are similar to those of pure Zr and Zr_4Co, respectively. During structural relaxation, the changes in the topological short range order are essential and are controlled by the nucleation-growth mechanism. When the nucleation number is sufficient, the segregations grow homogenously and identically.

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Magnetic Field Dependence of Quasi-Fluxon of Excitation in Circular Symmetric Annular Josephson Junction

40090073c Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 38 No 6, Jun 89 pp 938-946

[English abstract of article by Xu Kunming [1776 2492 2494] of the Department of Physics, Zhejiang University; Shen Yafei [3088 0068 5481] of the Department of Computer Science and Engineering, Southeast University; Yao Xixian [1202 1585 6343] of the Department of Physics, Nanjing University]

[Text] The movement of the ring-shaped quasi-fluxons in circular symmetric annular Josephson junctions is investigated numerically for the case when an applied magnetic field exists. The behavior of the quasi-fluxons in an applied field depends upon the geometric size of the junctions. If the width of the annular junctions is $5\lambda_J$ in the radial direction, the lifetime of the quasi-fluxon is increased by the applied field. If the width of the annular junction is $10\lambda_J$, the lifetime of the quasi-fluxon is increased as well and, in addition, some evident changes in the behavior of the quasi-fluxons occur during propagation and in the reflection at the boundary due to the applied field. The size of the first zero-field step increases with the applied field in the lower current direction. These changes are caused by an inhomogeneous distribution of the applied field in the junctions. A tunable resonator in the gigahertz-range using quasi-fluxons on a lossy large-area annular Josephson junction is also proposed in this paper.

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Geometric Size Effects of Quasi-Fluxon of Excitation in Circular Symmetric Annular Josephson Junction

40090073d Beijing WULI XUEBAO [ACTA PHYSICA SINICA] in Chinese Vol 38 No 6, Jun 89 pp 947-955

[English abstract of article by Xu Kunming [1776 2492 2494] of the Department of Physics, Zhejiang University; Shen Yafei [3088 0068 5481] of the Department of Computer Science and Engineering, Southeast University; Yao Xixian [1202 1585 6343] of the Department of Physics, Nanjing University]

[Text] In this paper, the geometric size effects of ring-shaped quasi-soliton solutions in the perturbed Sine-Gordon equations (SGE) in a circular symmetric annular Josephson junction are investigated using a numerical method. In the perturbed SGE, when the inner radius r_0 of the circular symmetric annular junctions is larger than or equal to $7.5\lambda_J$, a kind of ring-shaped quasi-soliton solution, corresponding to the quasi-fluxon of excitation in the circular symmetric annular Josephson junction, exists, as does the first zero-field step. The range of the first zero-field step depends strongly on the size of the inner radius r_0 and the widths (ar_0-r_0) of the circular

symmetric annular junctions, but the geometric size effects of the nature ofthe ring-shaped quasi-solitons are more complicated.

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Spontaneous Magnetic Moment, Specific Heat Anomaly in Heavy Fermion System

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[English abstract of article by Mao Xianglei [3029 0686 7191], Zhang Yuheng [1728 5940 1854] et al., of the Department of Physics, University of Science and Technology of China, Hefei]

[Text] In this paper, the authors point out that the heavy Fermion system is a kind of Kondo system whose localized f-electrons can change with temperature. The theory suggests the existence of a spontaneous magnetic moment in a particular temperature range. According to the different distances between the f-electron band and the Fermi level, there are different types of spontaneous magnetic mmoment effects. The authors also point out that the anomaly in specific heat versus the temperature curve is caused by the change in the number of f-electrons in a heavy Fermion system. The theoretical values of specific heat coincide well with the data of six experiments.

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Study of Adsorption Dynamics by SERS

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[English abstract of article by Zhang Pengxiang [1728 7720 5046], Pan Duohai [3382 1122 3189] et al., of the Institute of Physics, Chinese Academy of Sciences]

[Text] The authors have proposed a new method for studying adsorption dynamics by surface enhanced Raman scattering (SERS). A simple theoretical model of the adsorption dynamics for solid-liquid interfaces has been established. The authors analyzed the time dependence of SERS intensity and further deduced the parameters of adsorption dynamics, such as the constant of adsorption speed, and adsorption activation energy. As an example, the adsorption dynamics of P-amino-benzoic acid absorbed on a silver colloid were studied. The results show that the faster process of the time dependence of SERS is related to the adsorption process. From the experimental data and the authors' theoretical model, the constant of adsorption speed has been deduced. The authors believe that the study of adsorption dynamics by SERS is very promising.

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